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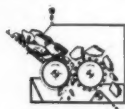
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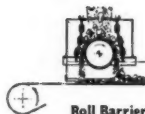
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The Mining Magazine

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EDITORIAL

A DRAFT Mining Code has recently been sent to the Council of Ministers in Saudi Arabia for legislative action. Prepared by the Legal Advisor to the Saudi Protectorate on Petroleum and Minerals Affairs, Mr. Frank C. Hendryx, the Code is the country's first piece of comprehensive mining legislation. It is said to be very liberal in outlook and should, once enacted, prove generally attractive to prospective mining interests.

IT is reported from Pakistan that the Government has decided to centralize all activities in connexion with minerals under a new Bureau of Mineral Resources. This will incorporate the Geological Survey Department and the Petroleum and Minerals Department and will be responsible for future mineral development policy. The new Bureau will be under a director-general, with joint secretary status, the first being Mr. S. M. Yusuf, C.S.P. Mr. C. Harvey Richards, who is on a Colombo Plan assignment with the Pakistan Government, has been attached to the Bureau as mining adviser.

L EAD production in 1958 is reviewed in a recent report¹ from the United States Bureau of Mines. In that year world mine production of lead decreased for the first time in 12 years, the decrease amounting to 90,000 tons, or about 3%. Of the larger producers there was less mine production of lead in the United States, Mexico, Yugoslavia, and South-West Africa and larger output in Canada, the U.S.S.R., and Morocco. In the same year world smelter production also declined but by only 1%. In Belgium, Canada, Mexico, the United States, and Western Germany smelter production decreased, but increased over the 1957 figures in both Australia and the U.S.S.R. It is noted that in the year the supply of lead exceeded demand by a wide margin, resulting

in rapid stock build-ups and depressed metal prices. United States Government acquisitions of lead, which in previous years had absorbed world surpluses, were greatly reduced. In the final quarter of the year quotas were imposed on lead imports into that country and there was a moderate upturn in consumption, as well as a rise in the market price of lead. A small but encouraging increase in domestic mine output is also recorded.

IT is reported by the Colonial Office that a record quantity of mineral products was exported from Cyprus in 1958. Shipments totalled 1,236,657 tons, as compared with 1,197,362 tons during the previous year, although lower prices for copper and sulphur products reduced the total value from £10,440,691 to £9,124,250. While increased mechanization resulted in a drop in the total number of shifts worked, the quantity of ore, rock, and waste handled at the mines and major quarries rose from 6,005,000 tons in 1957 to 7,959,000 tons in 1958. The annual report of the Inspector of Mines for 1958 points out that, despite the increasing use of heavy plant, there was a marked improvement in the year's accident statistics over the record safety figures for 1957. During the year the number of shifts worked fell by 13.1% as compared with 1957, while the number of lost-time accidents dropped by 41.5% and the number of lost-time shifts by 36.3%. Compared with five years ago, the mining industry in Cyprus is now working at the rate of 8,333 shifts per accident against 1,724 shifts.

British Standards Institution

The report of the British Standards Institution for the year to March 31 last¹ reviews developments in the activities of the International Organization for Standardization and of the International Electrochemical

¹ Mineral Market Report No. 2939.

¹ Annual Report, 1957-1958, Paper covers, 272 pages. Price 7s. 6d.

Commission and, indeed, emphasizes the growing demand of industry for new specifications on which to base both production and purchasing requirements. The range of products for which standards are in preparation continues to grow, at the same time as standards co-ordination continues to improve. The report calls attention, for example, to the revision of the many existing standards for steel and other basic materials, to progress on work connected with computers, and to continuing efforts to develop standards for smoke control. At the same time the growing support given by trade and industry to the work of the Institution is apparent from a further big rise in the number of new subscribing members; the total at March 31 last was 10,605—an increase of 6% over the previous year's figure.

The report refers to a growing awareness of the need to use standards effectively in production. "Efforts are continuing," it says, "to ensure as close contact as possible between B.S.I. and those who use standards, and to promote education in standardization through conferences and discussion groups at various levels in industry, as well as among students." Special efforts are also being made to see that technical colleges place emphasis in their courses on standards techniques.

Australia's Aluminium Outlook

In the August issue attention was drawn to a symposium on Aluminium in Australia held in Brisbane in July last. Convened by the Southern Queensland Branch of the Australasian Institute of Mining and Metallurgy with the support of the local branches of the Australian Institute of Metals and the Australian Chemical Institute several papers were submitted as a basis for discussion. One of these, by Dr. J. A. Dunn, was entitled "Australia and World Aluminium," but before examining his conclusions it would be as well to look at the bauxite resources of the Sub-Continent, which were examined in a previous paper by G. A. Daniels and S. F. Derbyshire.

These authors point out that although the existence of bauxite in Australia has been known for many years it is only during the last four years that areas in north Australia have come to be regarded as one of the major potential sources of this ore, in spite of the fact that B. Dunstan had in 1916 made the

prophecy "that laterite occurs somewhat abundantly in Queensland and it is almost certain bauxite will be discovered in association with it in quantities attractive enough for examination." However, the first investigation of the Melville Bay area was made by the New Guinea Resources Prospecting Company (a company owned to the extent of 51% by the Federal Government and 49% by the British Aluminium Co., Ltd.) in 1955 and this established the existence in quantity of pisolitic bauxite averaging 48% alumina and 3-4% silica on the Gove Peninsula. In the same year H. J. Evans, a geologist with Consolidated Zinc Pty., Ltd., when visiting the east coast of Cape York, realized the tremendous potential the pisolitic laterites in that region would have if they were of sufficient high quality for aluminium production.¹ Subsequent investigation by Enterprise Exploration Pty., Ltd., a subsidiary of Consolidated Zinc Pty., showed that these deposits were mainly metal-grade bauxite, and a new company—Commonwealth Aluminium Corporation Pty., Ltd. (owned 50% by Consolidated Zinc Corporation and 50% the British Aluminium Company)—was formed to follow up the examination and the use of these bauxitic ores. This examination included surveys of both the areas at Gove on the west side of the Gulf of Carpentaria and also areas on the east side of the Gulf lying along the west coast of Cape York. The tonnages of metal-grade bauxite in the whole of these districts is not accurately known, but it is estimated that the reserves may be more than 3,000 million tons, of which at least 2,000 million tons will be metal-grade, averaging 55% alumina, 3.5% reactive silica, and 1.5% quartz. In addition to the above quantities of ore a further 21 million tons is known to occur in other states of Australia except South Australia.

It is in the light of the results of this exploration work that Dr. Dunn examines Australia's position in regard to world markets. It is clear, he says, that there is no permanent market for Australian bauxite in Europe, nor in the United States as one can see it at present, unless political problems in Africa were to inhibit or delay the development of the larger projects there. If that were to happen there might well be some European market for Australian alumina in the latter part of the 1960's and early 1970's he suggests, but it could well be competitive with

¹ See THE MINING MAGAZINE, Aug., p. 78.

alumina from the Caribbean and perhaps from India and even communist countries. He considers, therefore, that the obvious scope for aluminium reduction in Australia is the domestic market itself. In 1959 Australia requires just on 30,000 tons—well in excess of Bell Bay's capacity, 13,000 tons, which has not so far been attained. Her consumption per head is amongst the lowest of western countries; to be comparable to West European countries and Canada, Australia's consumption should at present be 40,000 tons a year, and to be comparable with the U.S. it would be 80,000 tons. Aluminium marketing has not until recently been vigorous in Australia and there is great scope for further usage development. Dr. Dunn does indeed conclude that the construction of an entirely new plant for additional demand may well be warranted, but says that whoever goes ahead with a larger reduction plant in the future in Australia must play a leading domestic role in fabricating and in market development. Vigorous expansion of the market might be further implemented following vertical integration of the industry—that had been amply demonstrated by the major producers overseas. The immediate objective could well be the initiation of such a plant, for which the capital requirements would be great, and taxation amelioration might well be an important factor in such development.

Diamonds from Angola

The Companhia de Diamantes de Angola (Diamang) owns the exclusive rights to search for and mine diamonds in this African province of Portugal. It is in charge of an industry which continues to expand, operations in 1958, reviewed in the company's annual report, resulting in a greater volume of soil moved and gravel treated than in any previous year. In the course of the year, following the removal of 9,263,404 cu. m. of soil, 2,341,055 cu. m. of new gravel was treated and an average yield of 0.41 carat per cu. m. obtained, a figure which exceeds by 12% the result for the previous year. The total output of diamonds in 1958 amounted to 985,644 carats, while 15,592 carats were obtained during prospecting work. The report says, in addition, that for the first time in the history of the company more than half the gravel treated was obtained mechanically. At the end of the

year there were 22 mechanical excavators employed solely on this work and recently this number has been increased by two shovels of English manufacture which, with the two draglines already in operation, should soon be erected and start working. The Luachimo hydro-electric central station, which continued to function throughout the year, supplied practically all of the electric energy used in the mine workings with a production for 1958 of approximately 18,119,000 kWh. This compares with 300,000 kWh which is about the figure of the production of all the other stations operating in the Province during the same period.

Diamang continues steadily with its prospecting and in the year under review as many as 13 teams were at work at various times. In the hydrographic basin of the Cuango some new small pockets containing very small but rich deposits of gravel were found between the rocks lining the banks, the average yield being 100 carats and even 200 carats per cu. m. In 1958 14,400 carats of diamonds of a good average size and in the majority of cases of good quality were collected from these pockets. At the same time development work carried out in deposits previously discovered has resulted in four new areas being included in the reserves, the total capacity of which has been computed at about 464,000 cu. m. of gravel containing approximately 468,000 carats of diamonds.

Further evidence of kimberlite formations was found during the geological studies, it is reported, all of them, six in number, being in the Luachimo basin, so that the total number of these is now 19. Of these the one on the Caixepa stream is the most interesting on account of the large number of diamonds of excellent quality and good average size which have been collected there, either from the Kimberlite rock or from the existing deposits of gravel nearby.

The financial success of this company is of course of prime importance to Angola. For the year under review the amount due to be paid to the Province for its participation in the profits is Esc. 87,727,169; this brings the total paid during the last 39 years to £18,098,643. During the year the Government repaid the third instalment of the loan, of Esc. 100,000,000 made in 1955, plus interest, out of its participation in the profits for 1957, the balance of the loan thus being reduced to Esc. 81,250,000.

MONTHLY REVIEW

Introduction.—The announcement that there is to be a General Election next month has naturally introduced a degree of uncertainty in general business dealings. Meanwhile, with the steel strike in the United States continuing, metal prices continue surprisingly steady in the absence of a marked consumer demand.

Transvaal.—The output reported for the Southern African gold mines for July was 1,700,968 oz., making with 48,144 oz. from outside mines a total of 1,749,382 oz. for the month, which is, as was noted in the August issue, another record. At the end of July there were 381,190 natives at work in the gold mines, as compared with 383,903 at the end of June.

In the middle of August shareholders of WEST DRIEFONTEIN GOLD MINING were informed that the Carbon Leader had been intersected in No. 5A subvertical shaft on August 10 at a depth of 993 ft. below the collar on 18 level. The exposure was complete and the 16 sections sampled around the periphery of the shaft averaged 290.8 dwt. per ton and with a uranium value of 3.32 lb. per ton over a reef channel width of 9.1 in. equivalent to 2,646 in.-dwt. and 30.2 in.-lb., respectively.

At the end of August the JOHANNESBURG CONSOLIDATED INVESTMENT CO., LTD., announced that it had been officially informed that the Hon. the Minister of Mines had agreed to grant it a mining lease in terms of Section 20 *bis* of the Precious and Base Metals Act, 1908 (Act 35 of 1908 of the Transvaal), as amended, over certain portions of the farms Waterpan 292 I.Q., District Randfontein, and Modderfontein 345 I.Q. and Jachtfontein 344 I.Q., District Vanderbijl Park, Transvaal. The lease area will comprise approximately 2,230 claims (1,549 morgen). The consideration to be paid to the Government of the Union of South Africa in terms of the mining lease will be a share of the annual profits expressed by the formula

$$y = 12.5 - \frac{75}{x}$$

the symbol y representing the percentage of the profits payable to the Government and x the ratio of profits to recovery expressed as a percentage. In addition, taxation imposed by Statute on gold-mining companies will be payable on the profits after deduction

of the aforementioned lease consideration. It is stated that arrangements are in hand for the incorporation under the laws of the Union of South Africa of a company to be known as the WESTERN AREAS GOLD MINING COMPANY to take cession of the mining lease from Johannesburg Consolidated, together with certain other mineral and freehold rights. Full details regarding the new company, the assets to be acquired by it, and the manner in which it will be provided with capital funds are to be published shortly, it was added.

In the three months ended June 30 last the concentrators at ROOIBERG MINERALS DEVELOPMENT recovered 288 long tons of tin ore averaging 62.01% metallic tin per ton. The estimated working profit for the period is given as £27,472.

Orange Free State.—FREE STATE GEDULD MINES on August 21 announced that the deflection made in the prospect bore-hole, put down approximately 4,300 ft. south of No. 1 shaft, in the vicinity of the No. 1A Ventilation shaft, which, as was previously announced, was incomplete, assayed 166 dwt. of gold per ton over a true width of 5.28 in., equivalent to 876 in.-dwt. A second deflection, in which recovery was complete, intersected the Basal Reef, assaying 320 dwt. of gold per ton over a true width of 5.28 in., equivalent to 1,690 in.-dwt.

Northern Rhodesia.—The report of RHODESIAN SELECTION TRUST for the fourth quarter to June 30 last shows an estimated profit of £1,474,000, which brings the estimated profit for the full financial year to £4,757,000. In the three months to June 30 MUFULIRA COPPER MINES produced 26,699 long tons of copper and CHIBULUMA MINES 6,352 tons.

ROAN ANTELOPE COPPER MINES reports an output of 25,598 long tons of copper for the June quarter, making a total of 80,872 tons for the full financial year to June 30 last. The estimated profit for the year, subject to taxation, is given as £4,891,000.

At the annual general meeting of NCHANGA CONSOLIDATED COPPER MINES held on August 27 the resolutions increasing the authorized capital of the company and authorizing the issue of 21,000,000 shares were approved.

Gold Coast.—In the three months to June 30 last BREMANG GOLD DREDGING treated

2,144,800 cu. yd. of ground and recovered 13,218 oz. of gold, the working profit for the period being £61,340. In the quarter No. 2 dredge was closed for six days for overhaul, while No. 3 restarted operations on the Middle Offin areas on May 15 and entered the river on June 16.

Nigeria.—Last month the BISICHI TIN CO. (NIGERIA), LTD., announced that in order to finance the current programme of expansion and to meet past expenses it had been decided to make an issue of 778,025 shares of 2s. 6d. each at 3s. a share. In a circular to shareholders the directors state that at the end of 1955 the reserves of columbite amounted to 812 long tons at an average grade of 0.182 lb. per cu. yd. and at the end of 1956 tin reserves stood at 2,090 long tons at an average grade of 0.593 lb per cubic yard. At the end of 1958, after deducting production in the intervening years, proved reserves amounted to 5,827 long tons of columbite, of which over 5,000 tons are represented by ore of a grade exceeding 2.25 lb. and 2,715 long tons of tin at an average grade of 0.465 lb. per cu. yd. As was stated by the chairman in his last review, the company has sold profitably all its production of columbite in sight for 1959 and some for 1960. Bisichi's columbite is asked for, it is stated, owing to its freedom from impurities and its high niobium/tantalum ratio and since the annual meeting further sales have been made and another columbite area is being brought into production. Negotiations for the acquisition of other properties are in an advanced stage and the company is rapidly becoming one of the principal producers of columbite, the future of which seems to be reasonably well assured, shareholders are informed.

At extraordinary meetings to be held later this month shareholders will be asked to approve resolutions implementing a scheme of amalgamation between UNITED TIN AREAS OF NIGERIA, LTD., and RIBON VALLEY (NIGERIA) TINFIELDS, LTD.. The scheme proposes that Ribon Valley shall go into voluntary liquidation and its assets acquired by United Tin. United Tin's capital of £150,000 in 1.2 m. stock units of 2s. 6d. is to be reduced to £50,000 in units of 10d. These will then be consolidated into 2s. 6d. shares after which the capital will be restored to its former £150,000. Ribon Valley shareholders will receive one of the new shares for every three Ribon Valley 2s. units held. United Tin shareholders will hold one-third of their present number of shares if the scheme is

approved. The reports of both companies for the year ended March 31 last have been issued. Ribon Valley suffered a loss of £1,498 and United Tin Areas one of £7,987. It is thought that the scheme will enable operations to be continued on a more efficient basis by enabling work to be concentrated in the most economic areas.

Tanganyika.—In the three months to June 30 last GEITA GOLD MINING milled 55,900 tons of ore and recovered 10,836 oz. of gold. The working profit for the period is given as £12,264.

Angola.—The operations of the ANGOLA DIAMOND COMPANY in 1958 are reviewed elsewhere in this issue. The accounts for the year show a profit of Esc. 87,727,169 and a total of Esc. 133,358,152 available. An interim dividend paid in January last required Esc. 25,950,000.

Australia.—Last month the directors of MORNING STAR (G.M.A.) MINES N.L. announced that it had been decided to discontinue development and diamond drilling, to mine the remaining ore reserves, and to withdraw underground machinery preparatory to closing the mine and selling the company's assets. During the last three years 6,800 ft. of development and 8,600 ft. of diamond drilling have been completed in the reefs between No. 19 and No. 24 levels of the mine. This exploration located five minor ore-bodies on the 20, 21, and 22 levels which are now exhausted. The chance of finding a major ore-body in this section of the mine has been eliminated by the development already completed, it is stated, and the board has therefore most reluctantly come to the conclusion that further expenditure on development is not warranted.

The operations of the WESTERN MINING CORPORATION in the year to March 31 last resulted in a profit of £A308,444, which compares with £A259,970 for the previous year. The consolidated profit of the company and its subsidiaries was £A831,960, of which £A459,259 was attributable to the company from its own profits and its interest in the profits of subsidiary companies and £A372,701 was attributable to the interests of minority shareholders in the subsidiary companies.

Malaya.—Shareholders of MALAYAN TIN DREDGING were informed last month that the construction of the company's new No. 4A dredge had been completed. The dredge was started up on July 28 and has since proceeded at flotation depth to a previously

prepared face and it is reported that the machinery is operating satisfactorily. The dredge has been granted an assessment under the Tin Control Regulations and it is expected that the regular production of tin ore will shortly commence.

With the recent dividend notice shareholders of TRONOH MINES were informed that the profit for 1958 was £256,134, against £761,966 for 1957. For the same year SOUTHERN TRONOH TIN DREDGING profited by £23,625, which compares with £167,629 for the previous year.

India.—During 1958 the INDIAN COPPER CORPORATION mill treated 442,088 short tons of ore averaging 2.164% copper. This being 1,417 tons over the previous year, another record. In the concentrator 36,892 short dry tons of concentrates of an average value of 24.959% copper were produced, against 35,674 short dry tons of an average value of 25.447% copper in 1957. In the smelter 7,841 long tons of refined copper were produced. The total ore reserves for all mines at December 31, 1958, show an estimated increase of 183,390 short tons at 4,034,147 short tons as compared with 3,850,757 short tons at the close of the previous year, with an average reduced value of 2.51% copper over an average stoping width of 78 in. The year's accounts show a profit of £997,848 and £1,118,209 available, of which a dividend equal to 18% free of tax requires £246,834.

Burma.—At the adjourned extraordinary meetings of the CONSOLIDATED TIN MINES OF BURMA, LTD., held on August 31, to consider the winding up of the company, the chairman Mr. W. J. C. Richards, stated that proposals regarding an offer for the shares were still under consideration. The meetings were accordingly further adjourned until September 28.

Colombia.—In the three months to June 30 last PATO CONSOLIDATED GOLD DREDGING treated 4,669,000 cu. yd. of ground and recovered 25,599 oz. of gold. The report for the period states that Dredge No. 4 was out of production for the first six months of 1959, while on its flotation move, which started in December, 1958. The dredge was not expected to be back in production until mid-August. The net profit from the dredging operation for the six months ended June 30 last, subject to audit and year-end adjustments, is estimated at \$300,000, which compares with a net profit of \$700,000 for the same period last year.

Bolivia.—At the annual meeting of the ARAMAYO MINES IN BOLIVIA COMPANY held in Geneva in July the chairman stated that there was a considerable fall in the value of retentions on minerals produced from the properties in Bolivia during 1958. Retentions from tin concentrates were down to \$89,205, as compared with \$108,618 in 1957. Retentions on wolfram were only \$9,658, as compared with \$31,395 in 1957. Other minerals—such as, silver, zinc, bismuth and antimony—contributed \$86,703.31, against \$126,303.72 in the previous year. Thus the total income from retentions on all minerals fell to \$185,566 (Swiss Fr. 798,863), from a figure of \$266,198.58 (Swiss Fr. 1,140,660.90) in 1957. During that same period and from those same minerals the Bolivian Government obtained a net value, after deduction of smelting charges, of \$8,013,856. To the gross income from retentions must be added the revenue from investments—namely, Swiss Fr. 499,871 and also Interest and Sundries (Swiss Fr. 926). There was a final credit balance of Sw. Fr. 270,479, which was carried forward and added to the previous balance of Swiss Fr. 6,039,935.

Canada.—The report of the INTERNATIONAL NICKEL CO. OF CANADA, LTD., and subsidiaries for the six months ended June 30, 1959, shows net earnings in terms of U.S. currency of \$38,391,000. For the corresponding first six months of 1958 net earnings were \$21,401,000. The increase during the first six months over those of the comparable period last year resulted primarily from the revitalized demand for the company's products, it is stated. The major contributing factors were an increase of over 50% in the rate of nickel deliveries in all forms and the improvement in the market price for copper. The fears of the steel strike in the United States contributed to the heavy second quarter demand for nickel from that industry.

Portugal.—At an extraordinary meeting of MASON AND BARRY, LTD., to be held later this month shareholders will be asked to approve of the capitalization of £23,147 standing at reserve, as well as of a motion increasing the capital of the company from £210,000 to £1,000,000 by the creation of 790,000 new £1 shares.

Cyprus.—A progress report to shareholders of the ESPERANZA COPPER AND SULPHUR COMPANY issued last month states that shipments in the year to March 31 last totalled 66,730 tons of cupreous pyrite, 1,990 tons of concentrates, and 260 tons of

cement copper. It is reported that following a test of over 1,000 tons of Limni semi-oxidized ore, it has been decided to re-start milling operations, the proposal being to treat initially some 400/600 tons per 24 hours using all-flotation plant. A good return is expected from these operations. Exploration operations are progressively enabling the company to narrow the search for commercial ore. At present five areas are being systematically surveyed geophysically, and on all five areas initial drilling is progress.

United Kingdom.—TEHDY MINERALS, LTD., reports a profit of £7,870 for 1958, the accounts showing £27,818 available for appropriation. Of this amount dividends totalling 17½% require £7,740, leaving £20,078 to be carried forward. While revenue from mineral properties was slightly lower than in the previous year, the report says, investment revenue was up.

Consolidated Gold Fields of South Africa, Ltd.—At the extraordinary meeting of the Consolidated Gold Fields of South Africa, Ltd. held in London on September 7 the ordinary resolution increasing the capital of the company from £11,000,000 to £14,000,000 and the extraordinary resolution increasing the maximum number of directors of the company from 12 to 15 were carried.

Johannesburg Consolidated Investment Co., Ltd.—With the recent dividend notice shareholders of the Johannesburg Consolidated Investment Co., Ltd., were informed that the profit for the year ended June 30 last, subject to audit, was £990,266, after taxation. With the sum brought in and other allowances a balance of £1,299,352 is available, of which the dividend equal to 4s. 6d. a share requires £808,500. The notice states that the book value of the company's quoted investments, including those in subsidiary companies, at June 30, 1959 was £14,588,975; the market value of these investments at that date, based on Stock Exchange prices, was £25,162,027.

Kent Gold Areas.—The report of Kent Gold Areas for the nine months to March 31 last includes the consolidated accounts with those of the newly acquired subsidiaries—ZAMBESIA EXPLORING and the ZAMBESIA INVESTMENT Co.—as well as the group accounts which are consolidated with those of GEITA GOLD MINING. They show a profit for the period of £145,793 and £204,027 available, of which dividends totalling 3s. 6d. a share require £142,916.

DIVIDENDS DECLARED

* Interim † Final
(Less Tax unless otherwise stated.)

- *Anglo-French Exploration Co.—2s., payable Sept. 11.
- †Beralt Tin and Wolfram.—1s.
- *British South Africa Co.—1s. 6d., payable Oct. 9.
- *Central Provinces Manganese Ore.—11½%, free of tax, payable Oct. 1.
- *El Oro Mining and Exploration Co.—6%, payable Oct. 31.
- *Exploration Co.—6%, payable Oct. 31.
- *Falcon Mines.—6d., payable Nov. 9.
- †Geevor Tin Mines.—2s. and 6d. bonus.
- †Indian Copper Corporation.—18%, payable Sept. 30.
- †Johannesburg Consolidated Investment Co.—4s. 6d., payable Oct. 9.
- †Kent Gold Areas.—2s.
- *Konongo Gold Mines.—1½d., payable Oct. 15.
- *Kundang Tin Dredging.—3s., payable Sept. 16.
- †Lydenburg Estates.—1s., payable Oct. 20.
- †Mount Lyell Mining and Railway Co.—1s. 3d. Aust., payable Oct. 17.
- †Mount Morgan.—1s. 3d. Aust., payable Sept. 30.
- †New Union Goldfields.—7½%.
- *New Witwatersrand Gold Exploration.—10% and 2½% bonus, payable Oct. 23.
- †North Charterland Exploration Co. (1937).—1½d., payable Oct. 8.
- †Powell Duffryn.—10%, payable Oct. 3.
- †Pusing Rubber and Tin.—15%.
- †Southern Tronoh Tin Dredging.—3d., payable Nov. 11.
- †Transvaal and Delagoa Bay Investment Co.—7s., payable Sept. 21.
- †Tronoh Mines.—4d. and 6d. bonus, payable Nov. 13.
- *Witbank Colliery.—1s. 1d., payable Sept. 24.
- *Zaaiplaats Tin Mining Co.—1s. 4½d., payable Sept. 4.

METAL PRICES

September 9.

Aluminium, Antimony, and Nickel per long ton;
Chromium per lb.; Platinum per standard oz.;
Gold and Silver per fine oz.; Wolfram per unit.

	£	s.	d.
Aluminium (Home).....	180	0	0
Antimony (Eng. 99%).....	190	0	0
Chromium (98-99%).....		7	2
Nickel (Home).....	600	0	0
Platinum (Refined).....	28	10	0
Silver.....		6	6½
Gold.....	12	10	7½
Wolfram (U.K.).....		—	—
(World).....	8	3	9

Tin
Copper
Lead
Zinc

} See Table, p. 128.

Metal Prices and Modern Mining Finance

H. A. Hake

The author concludes
his brief review
of "Mining Finance
over 50 years"

Since the MAGAZINE was founded metal producers have repeatedly come up against the problem of selling their output. Sometimes the market has acted as a regulator, to the detriment of the price received, and this has eventually had the effect of persuading the high-cost mine that it was not possible to carry on. In contrast, there have been periods when fantastically high prices have been paid.

In the last 50 years the average annual cash price of copper has ranged from £30 in 1934 to £352 in 1955, the last price being reached under the influence of lengthy strikes in the copper mines of Northern Rhodesia and Chile. The price of lead has fluctuated between £11 per ton for 1934 and £162 in 1951, while its companion metal, zinc, has run much the same gamut, its range having extended from £12 in 1931 to £172 in 1951. The ratio between the extremes in the price of tin over this period is proportionately lower than for the other metals, although, generally speaking, tin commands the highest price of the the four main metals.

The pain and delay caused when the market has had to adjust supply to demand has led the producers to advance all sorts of schemes for a less painful method of adjustment. Soon after the ending of the First World War a copper association was formed to curtail production while war surpluses were liquidated. That association is generally accepted as having been a success; its aims were limited and it disbanded in 1923. A later attempt to regulate the price of copper was successful until, over-ambitious in its attempts to raise the price, a buyers' strike was precipitated and the association was liquidated. In the few years before the Second World War a new arrangement came into being: it was a cartel composed of producers outside the United States. In this phase of re-armament the cartel had the necessary conditions for being successful and only the advent of war caused its closure.

Rather less formal undertakings were accepted by the lead-zinc producers, although a zinc cartel was brought into existence during 1931, when the effects of the big depression was felt throughout the world. Many serious financial crises have occurred during the half-century under review but the biggest of all was that which started with the Wall Street collapse in 1929. It is not our province here to comment on the political consequences of that disaster, but it cannot be gainsaid that its repercussions are still being felt. The zinc cartel ended in December, 1934, and a little later a Lead Producers' Association was formed. On the whole however, restrictions on outputs of these metals were less rigid than those on tin, which has a long history of restricted production.

The course of tin prices during the late 1920's was unsatisfactory and by September, 1929, meetings were first held to form an association to deal with the matter. The proposal made at that meeting for a voluntary scheme for the limitation of production was timely, in view of the depression which attacked the world economy. By 1931, agreement was reached between the main producing countries and a tin stock was established to acquire a large part of the excessive stocks which overhung the market. The first agreement was for a short period, expiring at the end of 1933. It was immediately succeeded by another agreement, modified in some ways in the light of experience, and planned to run for three years. That in its turn was replaced by a third agreement, commencing in 1937; since it was to be operative for five years, it covered, as events turned out, the early years of the war. A fourth agreement was signed to cover the five-year period from 1942 to 1946, but the scheme was largely inoperative, because of the changed conditions of war. On the one side Malaya and Indonesia (then the Netherlands East Indies) were occupied by the

Japanese and on the other the use of the metal in the United States and the United Kingdom was controlled by Government orders. The buffer pool was liquidated. It seems feasible to suppose that the relative narrowness of the price fluctuations in tin was the consequence of the existence of these tin agreements. It is also logical to think that the relative success of the first series of agreements encouraged the producers to institute the second, now operating.

The 1939-45 war brought with it problems of providing sufficient metals. When it was over the rehabilitation programme continued those problems and in 1951 the war in Korea, by giving added urgency to the stockpiling of a long list of commodities, intensified those troubles. But for some time the tin producers had been of the opinion that some regulation of the industry was again necessary, if there were to be health for all producers. The low-cost producers were not impressed with the arguments for keeping the high-cost mine in being; nevertheless, an agreement was signed and ratified by May, 1956. At one time the scheme appeared to be in danger, but that patch has been passed and export quotas have been subsequently increased.

In recent years some of the copper producers have twice agreed on output cuts and there has been a limited restriction on production by lead-zinc mines. After a period of 20 years, during which mining companies faced unusual problems arising from the war and subsequent rehabilitation, they appear to be returning to the problems which occupied their attention in the first 30 years of the MAGAZINE's life. Many of the older leaders of the mining industry had forecast that such conditions would return and, conscious of the difficulties they had faced in earlier years, they had built up the resources of their companies to what appeared to be unduly high levels. However, these policies had failed to commend themselves to many shareholders who have wanted the distribution of such resources. Constitutional attempts have been made in some instances to induce directors to pay out the cash, but, in the main, they were fewer than one might have expected. Successes were even more limited and the take-over bid, which has become a recognized part of industrial life in this country, has been almost entirely absent from the mining scene.

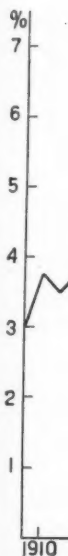
The biggest accumulation of resources is now in the hands of the De Beers Consolidated Mines group, where net current assets

amount to £93½ millions, taking book values, or to £105½ millions if the quoted investments are included at their market values. Current assets naturally have differing degrees of liquidity, but in this instance rather less than £15 millions is held in stores or diamonds, the remainder being in what is generally recognized as a more liquid form. The directors would probably be reluctant to consider these investments as being liquid, though in the last resort, they would be realizable.

Several of the tin companies have also built up their defences; in some instances quick assets exceed £1 million. At the end of March, 1958, Southern Kinta, for instance, held slightly more than £2 millions in Treasury bills or cash while the latest balance sheet of Tronoh Mines shows quoted investments and cash of over £1½ millions. Among the lead-zinc producers Consolidated Zinc Corporation has held over £5½ millions in cash or Treasury bills, some at least earmarked for a programme of re-organization, modernization and extension. In the copper world, the leaders have taken advantage of favourable opportunities to such an extent that the most recent balance-sheets reveal, to take a couple of examples, that Roan Antelope Copper Mines had £6 millions in cash or Government securities and that Rhokana had £5½ millions of balances with the Anglo American Corporation, in addition to £3 millions of loans and advances elsewhere.

This brief survey of some of the companies which are well breeched suggests that managements now are in a much better position to deal with the problems of imbalance between supply and demand than they were in the 1930's. It is also true that they have problems of a different nature. Not only do new plants cost a great deal more than formerly, owing to price inflation, but the size of such plants and their complexity, is generally greater. Undoubtedly this influence will lead to a continuation of the trend towards amalgamations and an increase in the power of the mining finance companies engaged in obtaining base metals, as well as those concerned with gold.

The movement towards vertical integration seems almost certain to persist. When Ndola Copper Refineries was formed to construct and operate an electrolytic refinery in Northern Rhodesia, one-third of the capital was subscribed by British Insulated Callendar's Cables, the remaining two-thirds coming from Roan Antelope Copper. The iron-ore

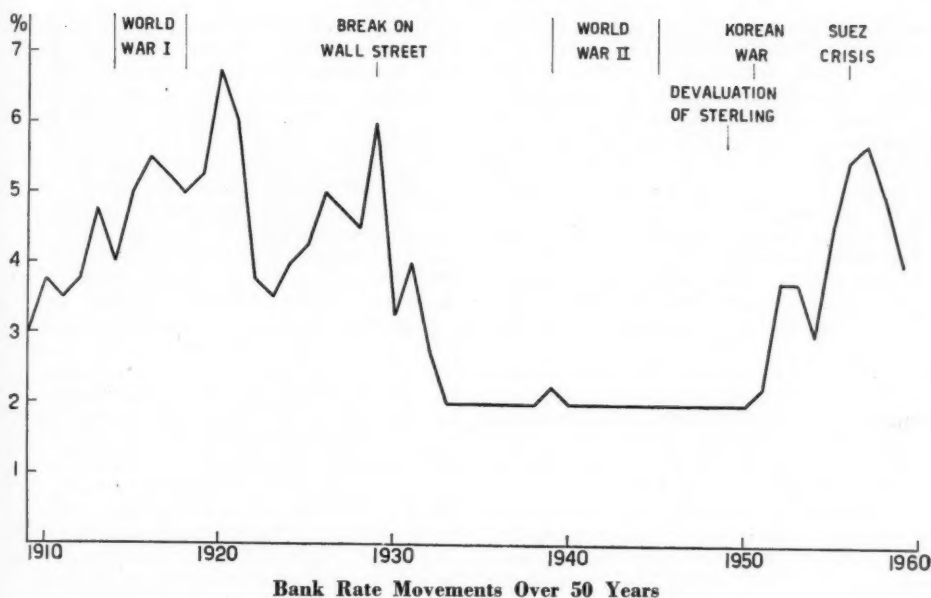


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deposits at Marampa in Sierra Leone are being developed by three companies, one of which is William Baird, the holding company interested in steel. In Canada, the iron-ore

companies are searching for potential customers, endeavouring to find those who have finance to spare, preferably without asking for a share of the equity.

Fifty Years of Mining Geology

G. A. Schnellmann, A.R.S.M., Ph.D., M.I.M.M.

If mining geology has little progress to record over the half century in its knowledge of fundamental principles and processes, it is far otherwise with the tools of the trade and the status of those who ply it. "The geologist" (again quoting McKinstry) "has nothing up his sleeve." He can see no further through a brick wall, or perhaps one should say a rock face, than the next man. His predictions are not based on clairvoyance but on logical inference drawn from systematic observation and measurement and based on the accumulated experience and knowledge of the behaviour of mineral deposits.

In this conclusion of

his article the author

reviews the modern

tools of exploration.

Field Techniques

Geological Mapping.—The basic technique in any application of geology to mining is geological mapping. Fifty years ago regional mapping could only be done the hard way, by foot-slogging and using a plane table in all sorts of terrain, making a factual record of rock types and structural data such as dips and inferring such items as contacts and faults, which in most cases of surface mapping are not exposed and therefore not capable of direct observation. Apart from being arduous and leaving a varying amount, depending on

the particular case, to personal judgment, this process was time-consuming, the more so in proportion to the difficulty of the ground. The advent of the aeroplane has brought with it the new technique of photogeology, which is perhaps by now sufficiently well known to mining men for a detailed description to be superfluous. It is not, of course, devoid of limitations, nor does it completely eliminate field work, since the collection of rock types and fossils is necessary for the interpretation of the aerial photographs—a geological ground control comparable with the trigonometrical control in the parallel technique of aerial survey. Its chief virtues are its speed and the surprising amount of structural detail which it can provide in favourable cases. Indeed, the criticism has in certain instances been made that the maps tend to defeat their object by presenting a wealth of detail incapable of interpretation. Another view of this of course is that it presents a challenge to the structural geologist by providing him with material, the significance of which he should assess, and statistical analyses to this end are known to be in progress.

Regional mapping is in general carried out by government through a geological survey department. The scale adopted varies, and it is not uncommon for official maps to be produced at more than one scale, but H.M. Geological Survey's scale of 6 in. to the mile—say, 1:10,000—is a large scale for country-wide maps. During the first decade or two of the MAGAZINE's life it became increasingly clear to mining geologists, particularly to those concerned with mine development, that geological data of significance in the location of ore-shoots could not be mapped in the requisite detail on such scales. This marked the emergence of the "structural control" school of thought, to which reference was made in the first half of this article. Its result so far as mining geological practice is concerned has been the emergence of geological maps to a scale not smaller than that of the mine plan—say, 100 ft. or 50 ft. to the inch and for some purposes even larger. At such scales the problem is not so much that of what amount of detail can be recorded as that of what details are worth recording—that is, the exercise of judgment to discriminate between significant and incidental detail. Vein-structure, -texture, and -filling are clearly important and in certain cases enable the geological map to serve also the purpose of an assay plan. Features other than the obvious details of mineralization

may also be significant to varying degrees in different cases—e.g., type of alteration of the country rock and environmental features such as the nature of the country rock and its structure as revealed by contacts between different rock types.

Geophysics and Geochemistry.—In the realm of field techniques, however, nothing within the lifetime of the MAGAZINE has been so novel as the introduction of geophysical and, more recently, of geochemical prospecting. The first of these in particular was perhaps too wildly acclaimed in its early days and in consequence suffered a period of reaction from which it has now emerged in proper perspective. Applied geophysics is based on the differences in physical properties between ores and rocks, or between rocks of different types. The properties of which practical use are made are magnetism, electrical conductivity, density, and elasticity. Broadly speaking it is the first two which have proved of greatest importance in mining, the two last named (better known as gravimetric and seismic surveys respectively) having found their greatest application in oil exploration. More recently, but in a highly specialized field, the radioactive properties of minerals and rocks have also been utilized. An account of basic principles, application, and instrumentation would be out of place here, but probably as good a general exposition as any is the Report of the Imperial Geophysical Expedition by Broughton Edge and Laby, despite its having been published as long ago as 1931. This report marked an important stage in the development of geophysical prospecting, as by an impartial and independent field investigation of the several methods it established the proper spheres of application and the limitations of the various methods.

Naturally, since that time, many of the limitations have been pushed back as the result of new techniques and improved design of instruments. In the case of gravimetric surveys, to quote perhaps the most striking instance of advance in instrument design, the torsion balance, which was a difficult instrument to transport under field conditions and a tedious one to use, providing only two readings per day of eight hours, has been superseded by the gravimeter, a robust and portable instrument which can be set up and read with the ease and speed of a theodolite.

The most recent development in technique has been that of airborne geophysics, in which the appropriate instruments are carried in aircraft and their readings automatically

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recorded. This not only has the obvious advantage of increased speed but extends the sphere of utility to terrain such as swamp-land, on which ground methods would be virtually impossible. In some cases important information may be obtained by duplicating readings at different flying heights which could not be obtained in any other way. It is not however claimed that airborne methods eliminate ground work. They are rather in the nature of reconnaissance surveys and any anomaly found would generally be investigated in detail by ground methods. Moreover, the airborne technique applies only to magnetic, radioactive, and certain electrical techniques.

Despite these striking advances in the application of geophysics to mining geology, it is true to say that the small scale and complex nature of the typical mining problem presents difficulties of interpretation which restrict the effective use of this valuable tool. If the writer might for a moment turn from a review of the past and attempt a prophecy for the future it would be that the time must come when mineral exploration is conceived in terms of mining fields rather than of individual ore-bodies. In those circumstances geophysics could play a role much more akin to that which it plays in oil exploration—namely, the detection of large-scale structures. Such, in fact, was the true nature of its function in the discovery of the Orange Free State goldfield, a strikingly successful application.

Geochemistry is the newest of the field techniques and perhaps, bearing in mind the early history of geophysics, its practitioners have been more restrained in their claims. Its fundamental theses, reduced to a simplicity which inevitably introduces inaccuracy, are reasonable enough; processes which give rise to an economic concentration of mineralization are quite likely to have dispersed it in trace quantities over a much wider area and the weathering of ore-bodies will likewise probably give rise to dispersion to an extent dependent on the solubility of the particular ion. The testing of this intriguing hypothesis has been made possible by developments in analytical chemistry which have shown that certain organic reagents form compounds with metals by means of which the latter can be detected in minute traces.

Although this technique is now an established part of mineral exploration programmes, research into fundamental aspects is still being conducted on a world-wide basis,

and it is not unfair to say that the time is not yet ripe for a complete assessment of its scope and limitations.

Drilling.—Once the necessary combination of field methods has established a *prima facie* case for the existence of mineralization it remains to test the prospect by obtaining physical samples. There is little if anything new to report over the years so far as new techniques are concerned. Except in the increasingly rare cases in which trenching, pitting, and adits are possible drilling remains the standard method, and advances have been almost entirely in the matter of mechanical improvements. The churn drill continues to be widely used and cannot be regarded as other than entirely satisfactory for certain types of work. For comparatively shallow holes it seems likely to be replaced by the "down-the-hole" type of percussive drill. Rotary drills of the type more commonly used in oil-well drilling are being increasingly used; like the churn drill, they normally produce a fragmental sample. An interesting development in this type of machine is the use of compressed air instead of water or mud as a medium for cooling the drill-bit and raising the sample to surface. Compressed air is also being used, though to a less extent, as the circulating medium in diamond drilling.

The diamond drill has not been superseded or even seriously challenged where core-drilling is deemed necessary, but there have been a number of developments in equipment. Bits are now rarely set by hand with a small number of large Brazilian carbonados, but either mechanically with bortz, or even by impregnating a powder of tungsten carbide and cobalt with small stones and sintering the mixture. These processes have made possible the use of smaller and cheaper stones. Core recovery has been vastly improved under adverse conditions by improved design in core barrels. The first advance in this direction was the introduction of the double-tube barrel, in which the circulating medium, most commonly water, flowed through the annulus between the two co-axial barrels almost to the bit, where the inner barrel terminated and the water then flowed out from the inside of the bit as before. This meant that the water was still scouring the core and tending to wash fragmentary core out of the barrel just at the critical point of entry. In order to obviate this, design has been still further improved by extending the inner barrel almost to the face of the bit, and

using a "bottom discharge" or "face discharge" bit, the water channels of which are longitudinal holes in the wall of the bit so that, as the name implies, the water discharges at the face of the bit.

All this, as was remarked at the outset, is advance in mechanical design. Technique (as distinct from operation or "drill running") has changed but little, but a practice which is finding increasing favour is that of deliberately deflecting a hole after it has reached its first objective so as to obtain a second intersection without drilling a complete new hole. The economy when deep drilling is involved is sufficiently obvious. The drill "log," or documentary record of the core, is still almost universally a graphic record accompanied by the geologist's written description, and necessarily therefore largely subjective. With the object of eliminating this subjective element a foot-by-foot coloured photograph on 35-mm. film has been used, but this practice does not seem to have found wide adoption. A camera which can be inserted in a bore-hole to photograph the walls has also been reported, but so far as is known has only been used in site investigation problems.

Laboratory Techniques.—When the MAGAZINE made its first appearance the preparation of thin slices of rock and their examination by transmitted light was already well established, with all the ancillary techniques. The only important advance in this particular field has been the development of "petro-fabric studies," the purpose of which is to determine the orientation of each mineral grain in order to establish preferential orientations. Although very much the vogue in pure petrology and tectonic studies, petro-fabric analysis has found little application in mining geology. Of far greater significance has been the development of that cacophonous analogue of petrography—namely, mineragraphy—by which the opaque minerals are examined under the microscope by means of light (both non-polarized and polarized) reflected from their polished surface. This has led to more accurate diagnosis of mineral species and to an appreciation of ore-textures and the relationships of the constituent minerals which have been of great practical assistance not only to the geologist but also to the mineral dresser. In this obviously important field of diagnosis X-rays are being used in the establishment of crystal structure and orthodox methods of chemical analysis are giving way to spectroscopic methods.

Status of Mining Geology

But when all is said and done, mining geology being a technology, the true measure of its progress is the extent to which it has become accepted in the industry it serves. This article opened with the assertion that 50 years ago the mining geologist was virtually unknown. Indeed, so far as the United Kingdom is concerned, a full-time course at university level in the subject was not established until after the 1914-1918 war. It is true to say that he is still widely regarded as something of a luxury, and in times of economic stress he is apt to be the first casualty. Nevertheless, he has during the MAGAZINE's lifetime become firmly established as an essential unit in the mineral industry. The search for new ore is still no doubt his primary function and as ore-bodies become increasingly difficult to find it can scarcely be doubted (particularly by those of us who believe in the Paley Report) that reliance on the science of mineral deposits must increase. "New ore" does not refer exclusively to new ore-bodies, however. The proper development of known ore-bodies and the investigation of their possible extensions place on the mining geologist the responsibility for the guidance of routine exploration and development. It is a natural corollary of this concern with ore reserves and of the geological mapping which it entails that sampling and assessment nowadays tend to be the prerogative of the mining geologist. Nor does his function end there, for the general geological environment of an ore-body may profoundly affect the choice of a stopping method. Through mineragraphy he can offer valuable, perhaps critical, advice on mineral dressing. He has in fact a function in every aspect of mineral exploration and exploitation. In 50 years, in fact, mining geology has grown from an embryo to an adult profession and has become an indispensable tool in the mining industry.

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Novel Drive for Shovel Loaders

N. Meitzen and Carl Meyer

Pneumatic and Electromechanical Shovels

The numerous types of compressed-air shovels do not differ materially from one another, the build-up of the mechanism and the system of the driving motor equally show many similarities. The mechanism shown in Fig. 1 can be examined.

The shovel forms a unit with rocker arm A-B which rolls down straight path A-C during motion. In consequence of this motion the centre S of the shovel describes a cycloidal path from the bottom position to the top stop, shown as a dotted line, the shovel being dumped by the pull of chain L. This chain joins the shovel body at F, where it winds over the guide arc of radius r_0 and afterwards, over two guide rolls, reels up on the sprocket drum G, driven by the motor through gearing. The chain reels up on the drum upon its own coils and therefore at constant number of revolutions of the drum the chain performs an accelerating motion because of the increasing radii of its coils. The acceleration may be taken for constant with good approximation, because the turn around of the spiral is not great; coiling up of the chain starts approximately from radius zero.

The authors review the
design of drive
mechanisms for shovel
loaders and describe
an electrohydraulic
equivalent.

In Fig. 1 an intermediate position is drawn as a thicker line. At this position the point of contact of the rocker arm is X, when the chain is coiling up on radius r_G . Thus its instantaneous speed is:—

$$V_L = r_G \frac{n_G}{9.55}$$

where n_G is the r.p.m. of the drum G. Point X may be taken at the position drawn for the instantaneous axis of rotation and therefore the velocity of point S of the shovel is:—

$$v_s = V_L \frac{r_G}{r_L}$$

Radius r_L has been drawn perpendicular to the line of the chain; the direction of velocity v_s is perpendicular to radius r_s .

Computed velocities v_s laid off from one point, according to direction and magnitude, yield the hodograph of point S. The shape of the hodograph curve depends on the change of number of revolutions n_G ; since the other quantities are invariable it denotes geometrical dimensions. The variation of n_G and the behaviour of the hodograph can be investigated for different drives.

(1) $n_G = \text{Constant}$. Within certain limits

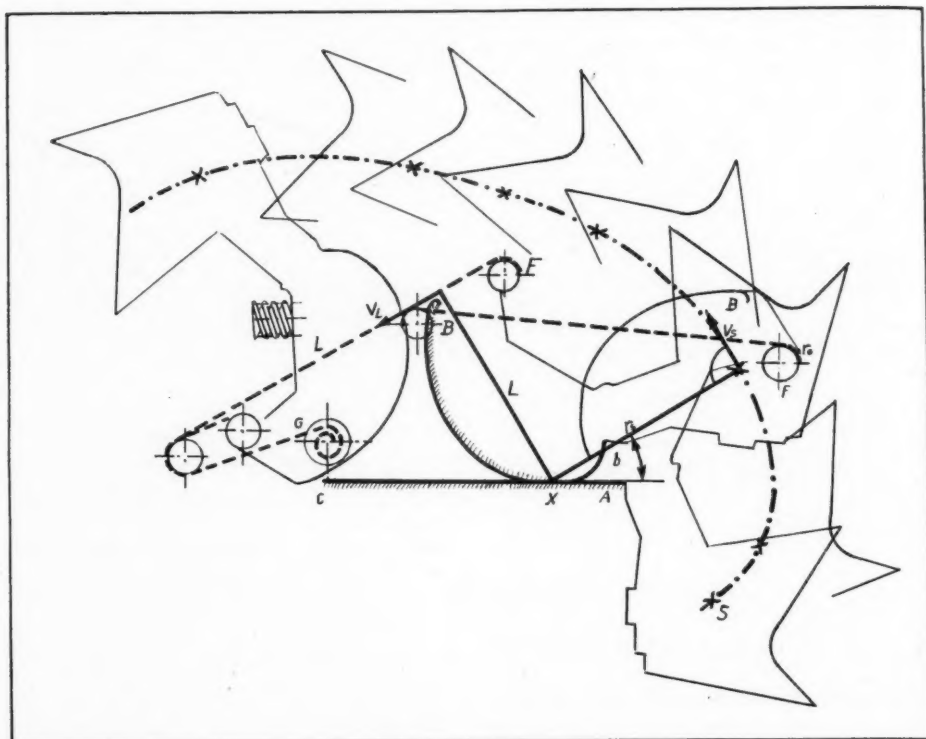


Fig. 1.

the three-phase electric motor and the constant-delivery hydraulic pump and motor transmission unit satisfy this condition. With increasing load the slip of the electric motor grows, the volumetric loss of the hydromotor growing at about the same rate. The variation of the number of revolutions is not important, the great increase of loading falling to the lowest section of the shovel lift. Before lifting the pulling chain is slack; when the lift begins the electric motor is already sufficiently accelerated and the shovel is lifted with a jerk. With these considerations in mind an ideal hodograph of $n_G = \text{constant}$ has been drawn in solid line in Fig. 2; the dotted line indicates the change due to about 10:4 slip arising at the lift. From the hodograph another unfavourable factor may be gathered—after lifting of the shovel takes place its swinging in from lateral into centre position; it is advisable to execute this centering of the shovel as

smoothly as possible. Therefore at this section lower speed of motion is needed.

(2) $M_G = \text{Constant}$; the torque on drum G is constant. This is the case of the compressed-air piston engine, or in hydraulic drive the unit composed of a hydro-motor of constant delivery and of a pump whose rating can be varied with the load. The shape of the hodograph depends in this case on many circumstances; the pull of the chain and the magnitude of the static moment determined from the geometric of the drive, as well as the value of the acceleration acting on point S of the shovel can be calculated. However, the magnitude of acceleration also depends on the mass of the shovel (and the material carried in it) and on the position of the centre of gravity. Swinging over of the shovel is therefore quite different with the empty or nearly empty bucket in comparison with when it is filled. The hodograph curve shown in Fig. 3 has been plotted on the following assumptions:—

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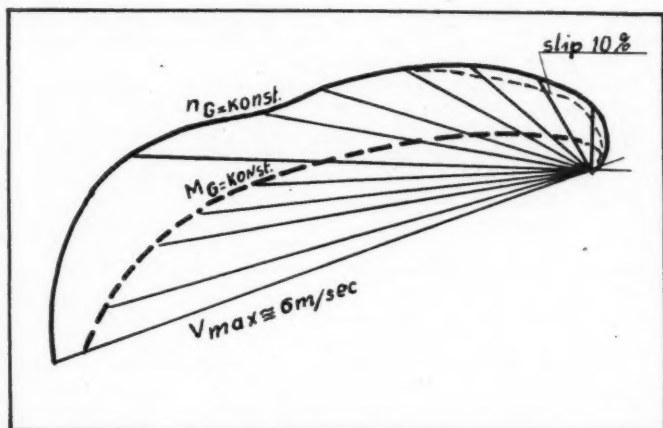


Fig. 2.

(a) Weight of the shovel and of the material contained in it is concentrated at point S and is taken in the given case for $S = 300$ kg.

(b) The value of the moment M_G has been taken in several positions differently great, so that the final velocity of the hodograph attains a value about equal to that in Fig. 2, in order to make direct comparison possible.

The equilibrium equation of moments about point S is given by the following relation:—

$$M_G \frac{r_L}{r_G} = S \cdot r_s \cdot \cos b - \frac{S}{g} r_s^2 \cdot a_g$$

The left-hand expression denotes the moment of the chain pull, balanced by the sum of the moments of weight and inertia. From the formula of the moment of inertia the angular acceleration can be determined. From the tangential acceleration computed from angular acceleration velocity vectors of point S have been determined by graphical integration. The hodograph curve is drawn in the broken line in Fig. 2.

It becomes evident at once that the curve obtained for the compressed-air engine has a much more favourable shape. The speed of lift and of the section following it is quite low, swinging in of the shovel into the centre is smoother, and at the low lifting speed the operator can produce the slight digging-in, shaking motion so necessary for picking up large lumps much more favourably. The great advantage of the air motor in driving the travel motion of the loader shows to advantage in picking up; the electric motor cannot even approach the slight forward-backward moves required in picking up, since run out of the motor is always more

than the operator wants. The quickly reversible air motor has a very great advantage in this respect.

Observation of the last section of swinging back shows that acceleration in pneumatic drive is much higher than in electric drive which makes a better control of the digging distance possible. The operator feels better when to shut off the engine for "rougher" and "smoother" throwing back of the muck. This is the main condition for uniform filling of mine cars.

When lifting period is investigated in respect of control it is found that deviation from the theoretical hodograph curve is of no great importance; it is only necessary that the operator shall be able to reduce the speed of lifting at will. It is especially desirable to control the sideways swinging back without jerking.

In what has gone before differences apparent in the mechanical operation of air- and electric shovels have been examined. It can be taken, however, that in both cases the electric motor or the air engine can be replaced by hydraulic drive and with proper control the appropriate characteristic curve attained. In the following notes design features are examined which lead to the most favourable development of the hydraulic drive.

Two solutions are possible; the electric drive of the dumping mechanism can be replaced by a hydro motor or by modification of the kinematics the tilting process can be executed by hydraulic cylinder. In deciding the problem design facilities are of great importance besides viewpoints of

principle, especially as regards operational safety.

When using a rotary hydro motor the usual mechanism can be retained intact, two methods of control being possible, the combination of a pump of variable discharge and of a motor of constant delivery, or the use of variable-discharge hydro machines in both units. In the first case the condition of constant torque is satisfied by controlling the discharge of the pump by means of a governor, keeping pressure constant. Since the torque of a constant-delivery motor depends on pressure only, this method of control can produce the hodograph curve of a pneumatic drive. The same could be attained by the use of a constant-discharge pump and a reducing valve. There is, however, a great difference in the efficiency of the two solutions and from the viewpoint of energy transmission another method would be better—i.e., a combination of variable-discharge pump and motor, so that the power input would be kept constant. Such a

method, however, involves the greatest possibility of failure and so would not present appreciable advantage.

The use of a rotary hydro motor presents great difficulty from the viewpoint of design. Space demand of the pump unit and of the oil tank can only be satisfied with difficulty, because the machine has to be of reduced dimensions. As is shown later, it is not advisable to adhere too closely to the solution with the rotary motor because very favourable kinematic conditions can be attained by the use of a hydraulic pulling cylinder and a very simple electro-hydraulic system—that is, by inserting a hydraulic pulling cylinder the pulling chain, the most delicate element of the machine, can be dispensed with. Covering of the hydraulic pulling cylinder can be effected very favourably and no operational failure is to be feared.

Hydraulic Dumping Mechanism

The kinematics of the dumping mechanism fitted with a hydraulic cylinder are shown in

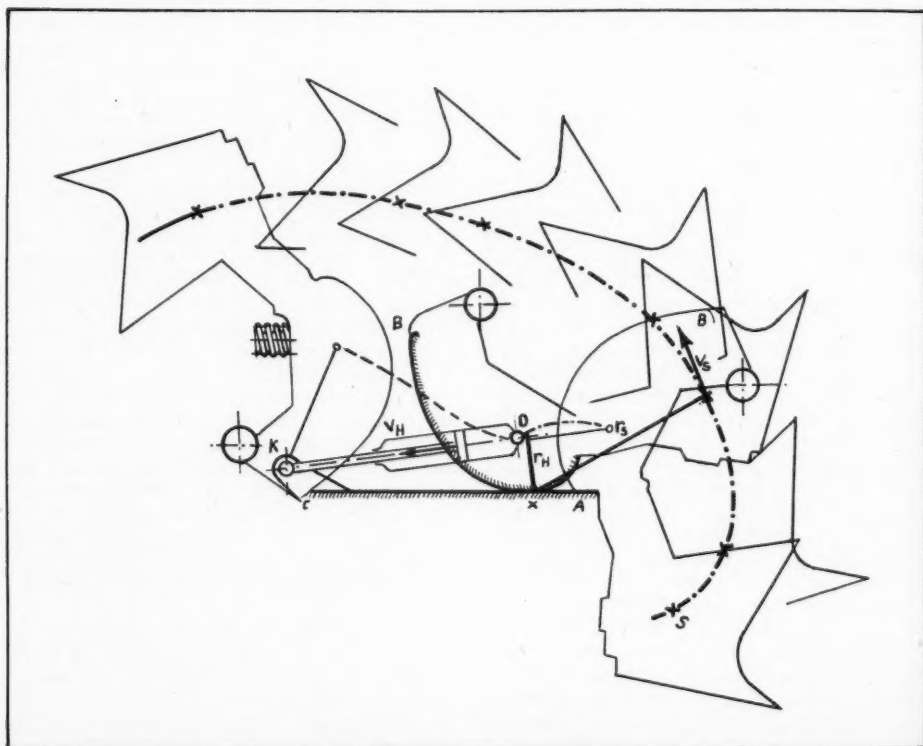


Fig. 3.

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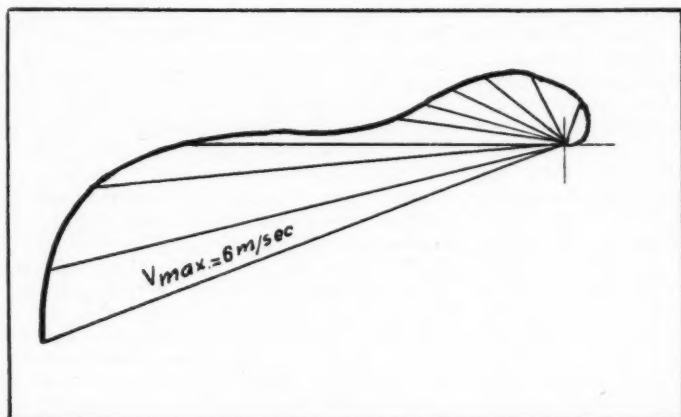


Fig. 4.

Fig. 3. Comparison with Fig. 1 shows that rocker-arm A-B, the base line A-C, and point S of the shovel are the same as in the electric solution sketched in Fig. 1; the cycloidal path described by point S is therefore also identical. The hydraulic pulling cylinder is hinge-jointed at point O of the rocker-arm body and the other joint of the cylinder joins the underframe at K. During the process of dumping the point O of the hydraulic cylinder moves along the thick broken line drawn in the figure. As in Fig. 1 an intermediate position has been presented here. The hydraulic cylinder is fed by a

constant-delivery hydraulic pump and the speed of travel v_H of its piston is constant. The magnitude of speed v_s therefore is obtained from formula:—

$$v_s = \frac{r_H}{r_H} \cdot v_H$$

With the aid of this formula the motion hodo-graph can be drawn (Fig. 4). The magnitude of speed v_H is to be set so that the speed of the shovel in the ultimate position be identical with the maximum speed obtained in Fig. 2. With this value the curves of Fig. 4 and Fig. 2 are directly comparable.

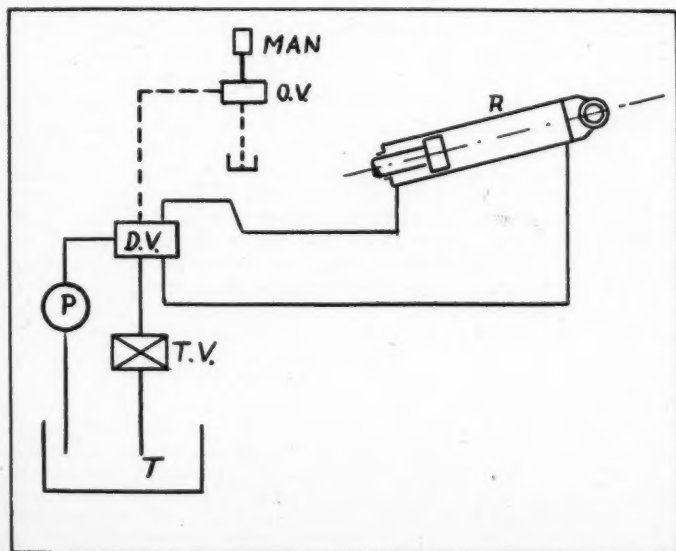


Fig. 5.

As is evident from the figure the hodograph of the hydraulic system is very favourable. Along the full stretch of motion it represents an intermediate state between the hodographs of the electric and the pneumatic system, but of particular advantage is the short acceleration period in the middle section of motion, which just falls to the period of swinging the shovel into middle position.

The starting section of the hydraulic dumping mechanism depends on the rate of speed up of the motion of the hydraulic cylinder to a constant. This period is fixed by the time of reversal of the hydraulic control and it is of utmost importance that this period of reversal shall be not too short. Although the hodograph shows that acceleration is fairly moderate the starting shock has to be reduced very much because of the large mass of the shovel. Since in conventional design the pulling chain can exert pull only, slinging cannot be controlled by breaking the driving motor and regulation is attained by the counter-torque of the shovel and the ratio of reduction of the chain pull only. Since the hydraulic cylinder produces thrust as well as pull a greater countermoment can be given to the shovel than before. This widens the possibility of control.

On all three hodograph curves the maximum shovel speed is about 6 m./sec. This throws the material a very great distance and good filling of mine cars requires this speed to be reduced, even to half value, and it can be reduced best by developing counter torque. This is especially important, because at swinging back and along the short stretch before it, the counter torque arising from the weight of the shovel is small. However, the thrust of the hydraulic cylinder has to be limited to prevent the rocker arm of the shovel from lifting itself from the path. The factors mentioned here basically affect the design of the hydraulic control equipment.

Loaders with pneumatic and electro-mechanical drive have two driving motors; hydraulic solution of a tilting makes one motor superfluous. Hydraulic pumps of the tilting mechanism will be driven by the propulsion motor on the underframe which drives the trailing axle of the loader. Since the hydraulic pump always rotates in one direction, the trailing axle and the pump will be driven through a gearbox. The electric motor will not drive the trailing axle directly, but by a jackshaft and a reversing clutch; the motor can rotate in one sense and

drive the pump by an intermediate gear. From the viewpoint of electric drive this solution is advantageous. No-load starting of the electric motor is possible and the motor can be kept rotating during loading. The electric outfit of the loader becomes very simple and there is no need for switchgear on the machine, starting and stopping of the electric motor being executed by remote control. Idle run of the hydraulic pump can be assured by using the safety valve as an unloading valve. Forward and reverse run of the trailing axles as well as their stopping is effected by the reversing clutch.

Claims for the hydraulic control equipment of the tilting mechanism have already been mentioned in dealing with the kinematic conditions. They may be summed up briefly: Shocks arising at starting of the hydraulic working cylinder have to be reduced; the magnitude of the thrust that can be developed by the cylinder requires sensitive control, and thrust control has to be independent of speed.

The working fluid arriving from pump P passes through a combined valve D.V., which communicates with the oil tank through the throttle valve T.V. Valve D.V. is a combination of a pressure relief and of a decompression valve in fact and is operated through the auxiliary valve O.V. The valve D.V. has two positions; when the shovel is swung back it connects with pump P the space of the working cylinder on the side of the piston rod; at the other position it connects both sides of the working cylinder and at the same time ties the discharge pipe of pump P through valve T.V. to the tank. Valve T.V. is set at low pressure. This pressure acts on both sides of the working cylinder R when the shovel has to be lowered. Since the piston surfaces on both sides of the working cylinder are different, the piston tends to be pushed outward, which speeds up lowering of the shovel. Counter pressure also acts as a brake in regulating the throwback. Regulation of pressure and counterpressure is easy and the shovel can be stopped at any position.

Conclusions

From what has gone before it is evident how it was possible to design a kinematically equivalent of a compressed-air-driven loader, but apparent that from the viewpoint of regulation and handling an electrohydraulic drive is more favourable.

From the viewpoint of operational safety

the two devices may be declared equivalent. A hydraulic tilting mechanism can be constructed in a very simple and safe manner. The driving electric motor can work under very favourable conditions and it can be started under no-load and kept permanently rotating during the process of loading. It is not necessary to stop or reverse the motor for switching, for lifting, for moving the machine, or for reversing the motion. The electric switchgear including many sources of faults is thus simplified and surges in the electric network are also eliminated.

The electro-hydraulic solution of shovel design offers many advantages, particularly when small loaders of low projection height are needed. It is easy to design the machine for full hydraulic operation—that is, to operate

the running gear and the shovel mechanism of the loader from a common current circuit. Synchronization of the two motions is practically seldom possible, so that in choosing the new driving motor a power rating scarcely exceeding that of one motor of the two air-motor solution has to be provided for.

Operation of an electric-driven loader is, from many angles, simpler than that of the compressed-air machine. Instead of steel piping of large diameter only flexible rubber cables are used. The efficiency of power transmission is high and therefore operational costs are lower than those of the compressed-air machine. In mines where no percussive air drills are used the compressed-air supply system can be entirely eliminated and electric drive of loaders is to be preferred in all cases.

New Coal and Coke Loading Installation for Emden

John Grindrod, B.A.

Combining careful handling so as to prevent shattering of the material with efficient utilization of the capacities of the ships' holds a new coal and coke loading installation has recently been brought into use at the port of Emden, Western Germany. Constructed by Demag A.G., of Duisburg, the new plant is being used for transferring coal and particularly coarse blast-furnace coke from railway wagons into sea-going vessels. Having a capacity of 790 cu. yd. per hour it has been so designed as to incorporate an existing wagon tippler gantry and is of the mobile type, capable of quickly serving the various holds of a ship in turn without the necessity of warping the vessel to different positions according to the holds being served.

In order to prevent fracturing of the material the device permits its gentle sliding from one conveyor to another, eliminating all falling, throwing, or grabbing operations. Although careful loading of a ship's holds had previously been achieved by means of bottom-dump buckets filled at the wagon tippler gantry, this system failed to distribute the material efficiently under the main deck

and the 'tween deck and trimming had to be resorted to.

Instead of filling the bottom-dump buckets, as hitherto the wagon tippler gantry now discharges into a trough-type feeder, which, in turn serves a belt-conveyor running longitudinally with the quay. Thence the material is transferred to a belt-conveyor bridge operating at right angles to the quay and fitted with a lowering device and a swivelling and extendable trimming belt-conveyor.

Capable of tipping 15 end-discharge wagons an hour the stationary tippler gantry spans five railway tracks, four of which are used for loaded wagons and one for empties. It hauls each loaded wagon on to a platform suspended from lifting ropes by means of which hoisting and lowering to required levels, as well as tipping, are accomplished. After being raised the wagon on its platform is transported sideways by means of the overhead trolley of the gantry, lowered and then tipped endwise, a trestle fitted with guides ensuring that the platform is correctly placed at the fixed tipping point. The plat-

Careful handling

combined with

efficient

hold utilization

form is equipped with a discharge hopper which terminates in an electrically operated round sliding gate.

This equipment can deal with the wagons whichever way they happen to be facing on the tracks. For those positioned with their discharge ends the wrong way round for tipping the platform is turned 180° before being put down on the track. On being hoisted the suspended platform and wagon is swung round into its correct discharge position by slewing the overhead trolley. With a lifting capacity of 60 tons, a span of 112 ft., headroom of 56 ft., hoisting speed of 59 ft./min., trolley travel of 164 ft./min., and trolley slewing of 2 r.p.m., the tippler gantry has a maximum handling capacity of 790 cu. yd. an hour, corresponding to about 270 tons of coke or 480 tons of coal, and it is to this performance that the entire new Emden installation is geared.

Since wagon loads are discharged intermittently and over a short space of time, while the longitudinal conveyor-belt delivering to the transverse loading bridge requires to be fed at a slower uniform rate, an intermediate equalizing device has had to be installed between the tippler hopper

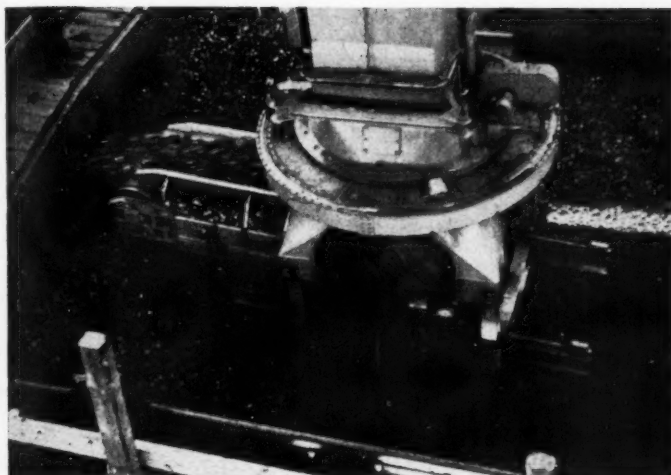
and the belt-conveyor. This takes the form of a mobile trough feeder which sheds its load on to the belt-conveyor during the interval of time between one wagon being removed and another being placed in position for tipping. With an overall length of 64 ft. and a maximum capacity of 59 cu. yd. the trough feeder, when receiving its load, moves at a relatively high speed from a right- to left-hand position under the sliding gate of the tippler platform discharge hopper. During this operation it takes about 20 seconds for the feeder to travel a distance of 46 ft. to reach its left-hand end position.

Forming the bottom of the feeder is a short 55 in. wide conveyor-belt with stationary terminal pulleys at 52 ft. 6 in. centres. This is attached to one end of the feeder and is set in motion when the latter is moved along. When the feeder is at the extreme right-hand position its bottom is open, while when it is in the extreme left-hand position it is closed.

Having received a wagon load of material the feeder trough moves slowly back to its original position, delivering the material by way of a chute onto the main longitudinal conveyor line which runs beneath it. Its speed can be adjusted to suit any size of

**View of
Installation at
Emden.**





**Lowering
Device and
Trimming
Belt-Conveyor.**

material within a range of 0 ft. to 3 ft. 6 in. per sec.

The longitudinal belt-conveyor, having a speed of 5 ft. 4 in. per sec., is 600 ft. long between terminal pulley centres and 47 in. in width. Its troughed upper strand is supported on three pulley idlers, correct alignment being ensured by adjustable idlers placed at intervals and tension being provided by a gravity-type take-up. It ascends to an overhead supporting framework and runs in an elevated horizontal position over a length of 355 ft., which distance corresponds to the maximum distance between the hatches of a 10,000-ton vessel. Delivery to the transverse belt-conveyor bridge can be effected at any point within this distance by means of a throw-off carriage which is moved along with the bridge and which feeds the material onto the fixed belt-conveyor within the bridge.

Spanning 175 ft. and having a headroom of 38 ft. 5 in. from rail level to the underside of the bridge girder, the belt-conveyor bridge has a fixed and a mobile rubber belt-conveyor 112 ft. and 157 ft. long respectively both of which operate at 6 ft. 3 in. per sec. The former extends from the feed point at the throw-off carriage to about the centre of the bridge, where it delivers the material on to the latter which is made up of four movable sections. The quayside end of the mobile conveyor is attached to the lowering device by means of a swivelling connexion and when the lowering device is retracted the mobile conveyor can slide under the fixed

conveyor. The bridge apron is capable of being raised or lowered in about 3 min., while the speed of travel of the bridge is 118 ft. per min. and of its trolley 66 ft. per min. On the quayside the bridge has an outreach of 69 ft. and on the land side 44 ft. 4 in.

The lowering device is of the elevator type, the material being carried vertically downwards at a speed of 2 ft. per sec. in compartments each having a capacity of 0.4 cu. yd. The compartments are formed in the shaft by a 34 ft. long, 3 ft. 6 in. wide rubber belt provided with integral collapsible plates. Having a minimum outreach from the centre of the bridge of 26 ft. 3 in. and a maximum outreach of 52 ft. 6 in., the device has an effective lifting height of 46 ft. and a lifting speed of 28 ft. per min. It is suspended by ropes from an overhead trolley and is raised and lowered by the hoist machinery. Transverse displacement within the ship's hold is effected by means of the trolley, while longitudinal displacement is effected by travelling the conveyor bridge. Since ship loading operations have to be carried out in certain sequence to avoid hull strain, the lowering device has to be moved frequently from hatch to hatch and appropriate operating speeds have been adopted for retracting it so as to reduce to a minimum the transfer time involved.

For spreading the material evenly throughout the hold of a ship a horizontal trimming belt-conveyor is used at the bottom of the lowering device. This is suspended from a

ball race and can be swivelled through 360° at a rate of 1.3 r.p.m. It can be operated with trimming conveyors of different length according to the size of hatch being worked and these can be extended to reach the corners of the holds. The belt has a width of $39\frac{1}{2}$ in. and its speed can be smoothly adjusted between 6 ft. 6 in. and 19 ft. 7 in. per sec.

Four points of control are incorporated in this handling system. All operations up to the placing of the railway wagons in the tipping position are controlled from a cabin on the wagon tippler gantry, while wagon

tipping, filling the trough feeder, and delivering the material onto the longitudinal belt-conveyor are carried out from a cabin over the feeder. A control point at the trolley of the conveyor bridge provides for moving the bridge, raising and lowering of the lowering device, trolley travel, and raising and lowering of the apron, while another cabin is located at the trimming belt-conveyor from which the latter is controlled and signals given for starting and stopping loading operations and movement of the bridge, trolley, and lowering device.

Ore-Dressing Notes

(6) Gravity Concentration.

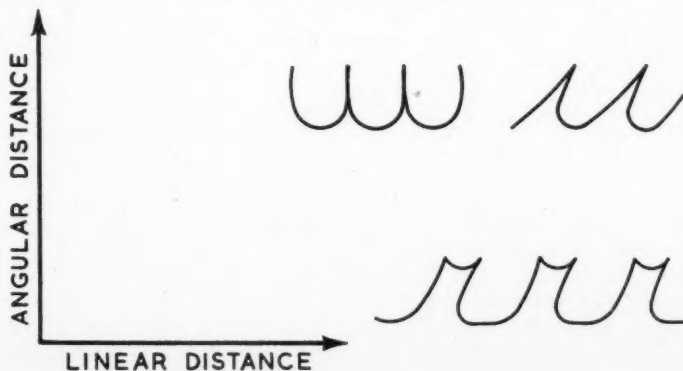
The Shaking Table (4)

In previous notes in this series attention was focused on optimum presentation of the feed. Consideration now turns to the correct application of the separating forces applied to this feed. Since the motion of the deck provides whatever force is exerted on the pulp the efficiency of table action is only fully attained when the various mechanisms, linkages, and slopes are properly set and accurately serviced. It is customary to set the table with its long axis horizontal and to maintain that setting, despite wear after the original installation. Variations such as a slight fall from feed to discharge end (lengthwise) may exist, but in view of the role of sluicing water in the riffles these, like the use of climbing action along the table, are of very doubtful value provided the general conditions for good tabling are being observed. The cross-tilt mechanism should ensure an

even slope along the full reach of the deck under working conditions. There must be no binding or unequal tilt to lead to local strain and resistance to correct vibrator action. This point should be checked periodically, because splash, rust, seepage, and neglect are apt to produce cumulative wear in the under-deck supports. Unless the deck moves with a minimum of mechanical resistance it is not possible to develop the best vibrator action and, consequently, the best compound cycle of throw and return.

Until an operator has seen the change in performance which can follow skilled attention to a neglected foundation he is hardly able to appreciate the difference between a free vibration and one braked by random frictional resistance. One point to look for here is loss of alignment at any pivot, rocking bearing, truss, etc. Unless each such point is so set as to be accurately aligned with the to-and-fro motion of the vibrator the whole operation suffers. In such circumstances the deck is distorted by the pulls and pushes of the bearing or transmitting links which are

Fig. 1.



out of alignment. The effect may pass unnoticed, since there is usually enough sand in the vicinity to provide a grinding paste which wears the system smooth. This, however, is only to substitute another kind of efficiency for the first. The vibrator is designed to produce a compound cyclic action such as those sketched in Fig. 1.

Backlash operates to dull the precision of the input vibration. It can do this by slack driving, which substitutes a jerk for the steady build-up from zero of the forward stroke, or by letting the return stroke overrun so as to produce a jerk at the completion, as the slack deck hits the increasing forward push of the next stroke. If the kinetics of sluice action discussed earlier in this series are recalled it will be obvious that sloppy movement of this sort cannot be correctly compensated merely by tightening the compressing spring in the head motion or by increasing the inclination toward the vibrator of the springs in a truss-supported deck, useful and important as these aids may be.

An indication of poor alignment is the starting torque, which in a well-aligned table is moderate. With wear this may rise to the point where bolts shear or fuses blow. The fact that once the table has started it runs smoothly may be misleading. Another useful indication of deck condition is obtainable by laying the unloaded table horizontal and observing the progress of a small coin along each of a number of riffles. If it proceeds steadily, with about the same forward throw with each stroke, all is well. If it tends to move from wall to wall of the riffle-groove this may indicate a misaligned or binding support. Although, broadly considered, the deck is a rigid body, it can register such resistances when it has acquired the elasticity conferred by over 10,000 impulses hourly over a period of years.

No attempt is made in these Notes to discuss the merit and relative values of the numerous types of head motion, setting, and modification. Textbooks, notably Taggart's manual, and technical literature provide a wealth of information regarding preferred length of stroke, which is always adjusted to give slower running with longer strokes and more abrupt "snatch" with coarser feed.

(7) Ion Exchange.

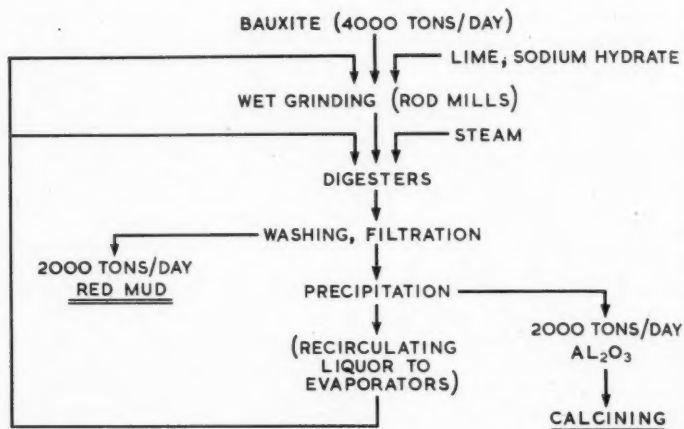
New Use for Zeolites

In a recent paper¹ C. B. Amphlett deals with some of the new uses of the natural inorganic zeolites. The earliest application of these substances was in such work as water softening and decolorization. They have been over-shadowed by the organic resins now in wide use, notably in uranium technology, but an appreciable amount of synthetic aluminosilicate is still used in water softening and new uses have been developed for other zeolites.

The basic action of an ion-exchange material is that it acts like an insoluble salt, acid, or base, in which one of the ions is fixed while the other is free to move. The mobile ion can be exchanged under suitable conditions for others of the same polarity. If the mobile ion is electro-positive the zeolite is cationic; if negative it is anionic. The special property of the zeolites in their newer uses is that their structures contain channels of defined sizes. These are occupied by cations and water molecules and also by additional anions. The lattice is rigid and this makes it possible for large ions to be arrested while those smaller can freely penetrate the zeolite. Hence the selective ability to exchange depends on the diameter of the channel and that of the intruding ion. Separating action resulting from this is termed ion-sieve separation. Molecular sieve action is also possible and depends upon the relationship between channel diameter and molecular size. Here physical adsorption on the internal surface of the structure must be obtained.

In addition to these rigid aluminosilicates there is a range of clay minerals in which the lattices have the aluminosilicates structure separated by cations and water molecules but rigid in two directions only. The structure is free to expand and selection is not, therefore, possible as in the zeolites. Ion exchange, however, is more or less unlimited in scope. When a zeolitic clay is heated to about 1,000° C. its structure changes and the power to swell on immersion in water is lost. Simultaneously ion-exchange power ceases and the cations inside the lattice are not readily leached out. The recent importance of this fact has developed through the suggestion that radioactive waste solutions from the processing of nuclear fuel could thus be sterilized. Harwell has had some success in

Fig. 2.

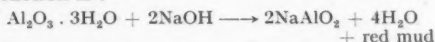


the use of vermiculite for the treatment of low-activity wastes and results were presented at the recent Geneva Conference on peaceful uses of atomic energy. The use of finely-divided clays offers good promise as a simple means of decontaminating active waters. It is also possible that a new use in connexion with mineral dressing may come of the further work being done on the natural zeolites and their synthetic prototypes.

(8) Chemical Treatment.

Aluminium from Bauxite

The Jamaican bauxite treated by the Reynolds Metal Co.—mainly gibbsite (a hydrous oxide) and boehmite—is low in silica but high in iron and is treated by a modified Bayer process.¹ The essential reaction is:—



In simplified form the flow-sheet is as shown in Fig. 2. Ore assaying 40% to 49% Al_2O_3 , 20 to 24% Fe_2O_3 , 2 to 3% SiO_2 and 2 to 3% TiO_2 is fed at minus 2 in. to rod-mills, where it is ground with spent liquor. Discharge slurry at 45% solids is minus 20 mesh. The slurry is digested for half an hour at 400° F. and 200 p.s.i., without mechanical agitation. Pressure is then reduced in four stages and the pulp is sent to settlement at 225° F. Settling is done in four-deck tray thickeners, which discharge red mud to C.C.D. washing followed by discard. The thickener overflow is filtered, cooled in heat exchangers to

150° F., and sent to precipitation in Pachuca tanks together with "seeded" alumina from storage. Here the solution is agitated with compressed air for 65 hours. As the solution cools Al_2O_3 precipitates down on the "seeds." The solids are removed by thickeners washed and filtered and then kilned with natural gas at 2,100° F. to yield 99% anhydrous alumina. The aluminous liquor remaining after precipitation passes via heat exchange to evaporating units and is then topped up with caustic soda and recycled. Some 50% of the Al_2O_3 thus returns, the balance going out as precipitated alumina.

Fiji Mineral Production

The 1958 report of the Director of Lands, Mines, and Surveys in Fiji shows that gold produced in the islands in that year was valued at £1,193,419, as compared with £1,017,808 in 1957. The value of manganese produced in 1958 fell from its 1957 figure of £470,207 to £262,892, but the report points out that the price of manganese ore dropped sharply at the beginning of the year from £18 a ton to £12 a ton for mineral containing 50% metal. This caused a small recession in the industry, since many mine-owners with marginal mines were unable to operate profitably and others were unable to produce a consistently high-grade ore to meet the more stringent specifications laid down by buyers. In spite of this set-back to the industry last year, however, Fiji manganese mining has developed remarkably in the last ten years, the report states. In 1949 only 100 tons, worth £1,200, were exported. Last year

¹ Eng. Min. J., May, 1959.

exports totalled more than 20,000 tons, worth over £342,000.

For 1958 the value of production from Fijian mines and quarries—in addition to gold and manganese—was: Silver, £8,883 (against £8,858 in 1957); copper ore, £3,034 (£4,665); limestone, £40,254 (£31,145); road metal, £103,928, (£76,056); iron ore, £8,931 (£3,900); sand and gravel, £89,400 (nil); coral sand, £17,761 (nil).

A Pioneer Metallurgist

Among the anniversaries to be celebrated this year that of the birth of William Champion of Bristol 250 years ago is of particular interest to miners and metallurgists. For Champion, the son of a Bristol Quaker, and not to be confused with the Champion who pioneered china-clay for Bristol porcelain, takes the credit for extracting zinc and being the first to do so in Britain.

Although the art of smelting zinc ores probably originated in India and became known in China—as witness Chinese literature of 1637 describing zinc utilization—a distinction should be made between zinc ores converted with copper directly to brass and zinc extracted for use *per se*. The Portuguese were importing zinc from the Far East a century before it was smelted in Europe and there is evidence on *zincum* being produced in Silesian furnaces in Agricola's "De Re Metallica" of 1556, while zinc extraction as a by-product of lead smelting seems to have been tried on a moderate scale in Central Europe. Calamine rather than zinc blende was the easier ore to work, as Von Schwab found when he distilled zinc from calamine first, but later succeeded with the sulphide ore; Von Schwab's success is dated 1742. Marggraf's extraction of zinc from calamines of English and Continental origin dates from 1746, while by 1752 Von Schwab and Cronstedt developed a zinc extraction industry for the Swedish Government so as to adapt zinc ores for brass-making.

It is against this background that one should assess the claim for William Champion as a pioneer in zinc extraction. His father and his brother John were engaged in the brass trade in Bristol and had patent rights granted them for the manufacture of brass and spelter by whatever rough technique prevailed up to then. The picture is completed by William Champion in 1730 really

setting about producing zinc to increase and improve the supply of spelter needed for home markets in face of the large imports. Since Champion petitioned the House of Commons in his cause the Journal of that assembly provides some detail to fix the claim for him. By 1738—that is, before Von Schwab and Marggraf put forward their methods—a patent was granted the Bristol man, enabling him to build an extraction plant which produced 200 tons before importers woke up to such competition. They brought down prices for spelter so low that Champion had to appeal to Parliament to avoid loss due to this action, an appeal backed by Birmingham and Wolverhampton users of Champion's spelter declaring it equal to any imported from the East Indies. The cause was none too successful, however, for although the House of Commons agreed to extend Champion's patent there was no offer to subsidize the Bristol zinc producer to help him meet some thousands of pounds expenditure on the process. A surprising opposition came from Preston merchants, one of the rare occasions that Preston appears in the history of metals.

How far it is correct to maintain that Champion got some of his knowledge from abroad is not easy to determine. He certainly travelled to a number of European countries to study the mining of minerals and metallurgical processes, this when he was perturbed at the £260 a ton charged for imported spelter. In the "Chemical Essays" of Richard Watson, that Bishop of Llandaff who as chemistry professor has written a history of zinc, there is a reference to an Englishman going from Bristol to Germany who had seen Champion's manufacture. Watson himself may have had Champion's secret process explained to him under promise not to publish it, yet 20 years later he did describe the process in his Essays. The "oven" was like a glasshouse furnace, he records, with six pots used which were 4 ft. in height, each pot having an iron tube inserted, this passing through the floor of the furnace to be cooled in a vat of water to condense the zinc. The pots held a charge of calamine and charcoal, while the zinc condensed from vapour was remelted into ingots for the Birmingham market.

Watson believed the Swede Von Swab (or Schwab) was the true inventor, yet that is difficult to prove. In so many of these early metallurgical processes there was sure to appear sooner or later the "spy in the

factory" theme; the old man, often a fiddler playing outside on a cold or snowy night, earning the sympathy of workmen who took him in to warm himself before the furnace. There out of a corner of his eye he would take in at a glance an entire metallurgical technique normally requiring months of effort to attain! William Champion, who died in 1789, was not of this type, but deserves notice on his anniversary simply because histories of zinc almost ignore him.

M. SCHOFIELD.

Book Reviews

Mechanical Properties of Non-Metallic Brittle

Materials : Proceedings of a Conference held in London in April, 1958. Edited by W. H. Walton. Cloth, octavo, 492 pages, illustrated. Price 90s. : 92s. 6d. post free. London : Butterworths Scientific Publications.

The Conference of which the Proceedings are published in the volume under review was held in London in April, 1958. Organized by the Mining Research Establishment of the National Coal Board in consultation with the Building Research Station of the Department of Scientific and Industrial Research, it was the occasion for the presentation and discussion of a series of papers which help considerably towards an understanding of the behaviour of non-metallic brittle materials.

The matter presented at the Conference occupied four sessions, in the first of which eight papers deal with strength in compression, bending, and shear. These essays show that many theories can be applied to the interpretation of data and that much work remains to be done in a field that gradually becomes more clearly defined. The seven papers in Session II deal with elasticity and creep in concrete, ceramic materials, carbon and graphite, and coal, while the seven of Session III cover dynamic loading, impact, and fragmentation. Here again, data are accumulating rapidly, but the interpretation discussed shows how much there is to learn which may yet assist prediction of results.

The last section of this useful collection of original works, dealt with in Session IV, embrace the "Action of Tools." In this session five papers treating of various aspects of coal cutting and ploughing embrace a wealth of original work which will also, in

time, enable a more rapid solution of the problems which arise in such work. The section completes a volume that will undoubtedly be consulted the more frequently as pit modernization pursues its inevitable path towards increased efficiency.

Proceedings of the European Congress on Ground Movement : held at Leeds University in 1957. Paper folio, 272 pages, in English. Price 42s. Leeds 2, Yorkshire : Mining Department of the University.

The European Congress on Ground Movement, held at Leeds University in 1957, was sponsored by the University of Leeds and the National Coal Board, and supported by the Royal Institution of Chartered Surveyors and the Institution of Mining Engineers. The aim of the Congress was to exchange information on the problem of ground subsidence in the winning of stratified deposits, principally coal deposits, and the volume under review constitutes the published record. In all 23 papers were presented by engineers from Britain, France, Netherlands, East and West Germany, Austria, and Poland. These, and the discussions which followed their presentation, are included.

The volume as a whole deals with surface movements, underground movements, laboratory experiments, and theory, the emphasis being upon the practical rather than the theoretical aspects of the ground movement problem. The similarity of experience and outlook between investigators who work in widely separated coalfields is well brought out in both paper and discussion.

The Proceedings are well produced with illustrations of the highest quality. It forms a work that will for a long time retain the authoritative status it obviously deserves.

Copies of the books, etc., mentioned under the heading "Book Reviews" can be obtained through the Technical Bookshop of *The Mining Magazine*, 482, Salisbury House, London, E.C.2.

Engineering Log

A feature article in *Lead*, a quarterly publication of the Lead Industries Association in the United States, described the development and perfecting of lead-bearing low-temperature enamels with melting points so low that they can be used on 24-gauge aluminized steel and on sheet aluminum itself. It is thought that they will be a boon to manufacturers of permanent outdoor

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signs, architects, and others searching for colour and extreme durability. Such enamels it is stated, have several unique properties; not only are they useful on much lighter stock than conventional enamels but they also form a thinner coat because they are more finely ground than usual porcelain frits. The reduction in shipping weight of fabricated products has already proved an important saving. Furthermore, desired opaqueness and finish can be obtained in a coat so thin that the enamelled sheet can be sawed, punched, sheared, or drilled without danger of serious spalling. Minor spalling which may occur in such operations leads to no corrosion problem since an aluminum base is used.

* * *

The history of the Mississippi basin has been one of continual war with that great river, to restrain its forces within the banks. To allow the water to reach the Gulf of Mexico more directly great meanders have been straightened out, the river diverted and sluiced away from threatened lowlands into reservoirs. At the same time vast weights of silt and sediment have been dredged out over the years to keep the channels clean. The first levees were erected at New Orleans not long after the French founded the city in 1718 and songs and folklore about them are a telling comment on the unending struggle which has been waged with Old Man River ever since. A flood in 1927, which left nearly 100,000 people homeless, finally released a Congressional appropriation for the increase in number and size of the levees, along the 975 miles from the confluence of the Ohio River with the Mississippi at Cairo, Illinois, to the sea. To date, close to 125 miles of modern revetments have been built by the U.S. Army Corps of Engineers along 275 miles assigned to the Vicksburg District, with a steady improvement as more stable materials were discovered and the old willow mattress gave way to the standard concrete mats of today. Three large pouring areas for the mats are located in the district and the sheets, 4 in. thick, are produced with assembly-line efficiency; 20 concrete blocks bonded by copper-covered steel wire go to the making of one articulated concrete mattress. The blocks are stacked 12 high, each stack measuring 3 by 4 by 25 ft., the stacks then travelling by giant wagon and river barge to the levee sites. The wagons are

equipped with compressed-air units on top, whose cylinders power the arms which lift the concrete wafer mattresses 8 in. from the ground for loading. The wagon backs on to its load so that these arms are astride the blocks, then clamps arms around it and moves off. These wagons, of which Vicksburg District has four, cost \$47,000 each and were designed specifically for the job. They are in use for six months of every year, before the high water incapacitates them, and are moved from site to site by barge. Barge-mounted cranes with air-motor-driven cables lift the concrete mattresses from the place where the wagons deposit them, each piece weighing 23 tons. Loaded barges are lashed together around a tug, which guides them through the river's strong currents to the low-country levees. Here bulldozers and draglines smooth the bank to a 3 to 1 incline and grade the river edge with gravel. The prefabricated mattresses are placed so as to line the inside of the levees and are launched from the barges by anchoring the concrete and tugging the barge from under it. Their bulk protects weak banks and the low land behind them and their smooth surface allows water within the banks to flow on unimpeded to the sea.¹

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A paper read by Dr. D. C. Martin to the Royal Society of Arts in March, 1959, describes the fascinating progress made during the International Geophysical Year by the combined scientific resources of the world. The planning took many years and some 4,000 stations participated, in addition to which there were several thousands of volunteer observers, 30,000 scientists, engineers, and technicians, and a total expenditure of £500,000,000. World data centres were in the U.S.A., the U.S.S.R., and a number of other countries, data collection being on an almost astronomical scale. The work for the World Meteorological Organization in Geneva, for example, was described on standard forms returned to the World Data Centre at the rate of 7,000 weekly. These are being reproduced on micro cards, each of which carries 40 to 96 forms, and 18,500 such cards will be required to report the meteorological data. On one section of 2,890 cards alone there are nearly 28,000,000 corrected alterations. The total may well exceed 178 million observations. Meteorological data will com-

¹ *Comp. Air Mag.*, July, 1959.

prise half of the total I.T.Y. observations and all of this will be published in due course in reduced form and made available in established scientific journals throughout the world. Among the activities were the Solar Patrol, in which a period of maximum sun-spot activity was closely observed. Wave and particle radiation were carefully checked and the results should give much valuable information on magnetic storms, weather, etc. Studies of the great land mass of Antarctica have also yielded invaluable information. More is now known of temperature, pressure, humidity, wind, etc., and geomagnetic and other records have been closely made. The new ice survey programme has shown that 40% more ice exists than was previously expected, the figure now being 45,000 million cu. miles.¹

* * *

Plans announced by the United States Atomic Energy Commission envisage the building of a two-mile-long linear accelerator at Stanford University as a national facility for research. Initially the machine planned will accelerate electrons to 10,000 to 15,000 million electron volts of energy and eventually it is hoped that the figure will reach 45,000. Construction will take about six years and estimates of cost are \$18 million for development, \$100 million for construction, and an annual \$15 million for operation. Two 35 ft. deep parallel tunnels, separated by several feet of earth, will house the accelerator, one containing the operating equipment itself, while the other is used for the evacuated tube, two miles long, along which a travelling radio-frequency wave propels the electrons in a straight line. Stanford already possesses the largest existing linear accelerator. This is 220 feet long and produces 700 million electron volts. The new machine, when fully developed, will be in the same category as the circular synchrotrons under construction at Brookhaven National Laboratory in the United States and in Geneva. The Stanford linear accelerator will make possible studies which cannot be made with protons and it will be more efficient than a synchrotron in accelerating electrons, since electrons accelerated in a straight line lose less energy by radiation than they do when accelerated on a curved path.²

General adoption of the printed circuit assembly method for radio and electronic equipment has given rise to a problem in the solderability of tinned copper wires. No problem existed in making sound joints between tinned copper wires and component terminals as long as the soldering irons were hand operated. Now, with the printed circuit method, all soldering is done by brief immersion in molten solder and the resulting joints are sometimes weak. Tinning of copper wires, which has been practised in the industry for many years, has two main purposes for electrical applications. One is to prevent any chemical interaction between copper and rubber when a rubber insulating cover is used over copper cable. The other reason—and the one relevant to this new problem—is to preserve permanently the quality of good solderability which freshly-drawn copper wire possesses. In assembly work it is not known at what point in its length the wire or cable may need to be soldered. By tinning the entire length good solderability is ensured at all points, without the inconvenience and loss of time involved in tinning during assembly. Tinning of copper wire has generally been done by the hot-dipping process. After traversing cleaning baths, pickling baths, and flux, the copper wire is run through a bath of molten tin and becomes coated. Large quantities are involved in such a process and speed is necessary. A dozen strands, each individually controlled, are drawn through the tin side by side. The wires drag out molten tin, of which some drains back to the bath, but most of the surplus has to be removed by rubber blocks. The thickness of the tin remaining on the wire is controlled by the pressure on the blocks. Wear on these rubber blocks is heavy and great vigilance is needed in adjusting them. A uniform grip, producing an even tinning and a wire which is true to gauge, is difficult to ensure. Once made the product is readily solderable, since the tin coating melts and fuses with the molten solder as soon as it is brought to soldering temperature. For this reason a hot-tinned wire which bears a sufficient coating of tin is generally superior in solderability to wire tinned by electrodeposition, particularly for printed circuit work. It is practicable, but not generally economic, to allow the plating time necessary in this electrodeposition process to build up a tin deposit on the wire comparable in thickness to the coating obtained by the hot-dipping process. The

¹ *J. Roy. Soc. Arts*, May, 1959.

² *Scientific American*, July, 1959.

intervening layer of copper-tin compounds which acts as a cement between copper core and tin coating is, moreover, absent in electroplated tinned wire. Without this cement it is not unusual for the thin coating of tin to dissolve in the molten solder.¹

* * *

The length of our day is measured by two successive transits of the sun, or of a star, across the zenith. Measurements made in this way show that our 24-hour day is growing longer at the rate of about 1/100 second per day per year. This is the figure arrived at by Professors Walter H. Munk, of the Scripps Institution of Oceanography, La Jolla, California, and Gordon J. F. MacDonald, of the University of California at Los Angeles. Their findings are to be stated fully in their forthcoming book from Cambridge University Press—"The Rotation of the Earth." What reasons have been offered for this phenomenon, which makes our day two hours longer than the day was 2,000 years ago? In effect, the sun's centre now passes the same zenith two hours later than it did at the time of Christ's birth. The reason is to be found in the gradual slowing down of the earth's rotation; any point on the globe now takes longer to return to alignment with its celestial measuring point than it did in preceding years. Edmund Halley, the 18th Century English astronomer, was the first scientist to be puzzled by discrepancies which he found between the astronomical dates for eclipses as given in Babylonian tablets on the one hand and Greek pre-Christian papyri on the other. Astronomers and mathematicians who succeeded Halley pursued the investigation of this problem and concluded that its explanation was to be found in the loss of energy in ocean tides. The two California scientists whose work is shortly to be published re-examined the tides and computed their forces to check this theory. The outcome is their rejection of this explanation, since tidal energy was found to be inadequate to account for the slowing of the earth's rotation. They have still not reached an explanation which is acceptable, but their researches on this intriguing topic will continue.²

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¹ *Tin and Its Uses*, Autumn, 1958.

² *Science News Letter*, June 13, 1959.

Atomic lamps developed by an electrical firm in Leicester can, it is stated, work 10-12 years without renewal of power supply. The experimental lamps are tiny, the size of twin matchsticks. Those which have so far been produced can already be used as indicator lights. Later, larger examples can be used for marking rafts, buoys, and road obstructions. They look like glass matches, with a thin stem leading to a modest bubble at one end. This bubble is phosphor-coated and the tube contains radioactive gas which emits rays and so causes the bulb to glow brilliantly. No other form of energy is required to maintain the light for a decade. The new lamps are still at the laboratory stage. Their developers claim that they are completely safe. In those in which tritium is used the weak rays do not penetrate the glass. Another gas used, krypton 85, requires some lead shielding of the lamp for complete safety from radiation hazards. The atomic lamps mark a major development in lighting forms.¹

News Letters

BRITISH COLUMBIA

August 4.

Cominco.—The Consolidated Mining and Smelting Co. of Canada, Ltd., has completed sinking the No. 1 pilot shaft at the Sullivan mine, Kimberley, and has commenced raising the main shaft; a heavy flow of water was encountered near the foot of the shaft. Sinking a new auxiliary shaft is in progress at the Bluebell mine at Riondel. The strip-mining operation at the Anderson mine of Montana Phosphate Products Co., Garrison, Montana, has been started again. The stockpile of phosphate rock at the Luke mine has been shipped to Trail and the Anderson stockpile is now being shipped.

Cominco has three underground exploration projects in progress this year. At the Wedge mine, in New Brunswick, a road has been built, a camp is under construction, and shaft sinking will soon be commenced. At the Duncan property, in the Lardeau district of British Columbia, a camp is being built and an adit has been advanced 100 ft. On the Double Ed property, at Anyox, construction of mine buildings and collaring of the adit have been started; the crew is temporarily living on floats moored on the beach.

Placer Development.—Placer Development, Ltd., has accepted an offer from the Hamer Corporation, of Midland, Texas, in the amount of \$12,190,437 for the whole of Placer's interest in the Coronet Oil Co. The company has intimated the funds may be applied to the development of other projects, notably its participation in Mattagami Lake Mines, Ltd., and in Craigmont Mines, Ltd., through its Canadian

¹ *Science News Letter*, June 13, 1959.

subsidiary, Canadian Exploration, Ltd. The estimated net profit of Canex for the year ended April 30, 1959, was \$200,000, which compares with \$1,095,800 in the preceding year. The closing of the Emerald tungsten mine and shutdown of the Jersey lead-zinc operation for six weeks during a labour strike were the principal causes of the decline.

Skeena.—A crew of eight men, including three geologists, is at work on the property of the Huestis Molybdenum Corporation, Ltd., at Pitman. Geological mapping shows the molybdenite mineralization to occur within a belt of pink granite so far determined to be 2,500 ft. wide and 6,000 ft. long. One diamond drill has been at work for the past two months and a second drill started in July.

An accelerated development programme has indicated extensions to the Jessie ore zone at Harriet Harbour, Q.C.I. Silver Standard Mines, Ltd., advises that hole No. 6 cut 84 ft. of 53% iron; No. 7, 42 ft. of 22.1%; No. 8, 99 ft. of 34.1%; No. 9, 149 ft. of 50%, and No. 10, 90 ft. of 55.7%. New outcrops 1,000 ft. to the east of the indicated anomaly suggest a new orebody or extension in that direction. At the same time an exploratory hole to the west has cut 40 ft. of ore-grade material. To date all holes have been driven vertically from surface. The company has refused an offer of \$1,000,000 for its Queen Charlotte holdings. At the annual meeting shareholders were advised that a minimum reserve of 2,000,000 tons of ore was expected to yield a profit of \$4 per ton. The object of the current work is to increase reserves to warrant an operation shipping not less than 360,000 tons of concentrate annually. It is estimated the property can be fully equipped for such production at a cost of \$2,500,000.

Alberni.—The first shipment of iron concentrate by the Haulpai Enterprises Corporation was made on July 21 from Head Bay, Vancouver Island. It contained 7,000 tons and was destined for Japan. A second ship is scheduled to load on August 15. The mine was prepared for open-pit operation in record time after the company acquired a lease from Canadian Collieries Resources, Ltd., last spring. The mill was commissioned on July 2 and is at present treating 100 tons of ore an hour, 16 hours a day, and 7 days a week. The camp is built on floats moored near the concentrator and shops which stand on the beach. Logs, anchored and braced 100 ft. offshore, serve as a temporary wharf at which ocean vessels can moor efficiently. An unique application of a conveyor-belt on a logging "A" frame facilitates loading of cargo into the ships' holds. Crushing produces four sizes: *Plus 2-in.*, *plus 1-in.*, *plus 1/2-in.*, and *minus 1/2-in.* The three larger sizes are handled dry on magnetic pulleys while the *minus 1/2-in.* material is picked up by the Dings wet separator. The mill and plant were designed by Wright Engineers, Ltd., the total complement being 35 men.

Victoria.—The fifth shipment of copper concentrate was made to Japan on July 19 by Cowichan Copper Co., Ltd., from Hatch Point, V.I. It contained 1,045 tons assaying 29.08% copper, with 2.9 oz. silver per ton.

Vancouver.—Taiga Mines, Ltd., has augmented its mining plant by the addition of another large diesel shovel, bulldozers, further drilling and blasting equipment, a crushing plant, and dump trucks, all of which arrived at the company's germanium property near Powell River on July 23. Metallurgical testing is being continued. Early results have

indicated effective extraction. The company's president, Dr. F. C. Buckland, states: "Although the actual grade of our ore zone is unproven, the average of our recent assays has been excellent. At this time it would appear that we will be mining a somewhat narrower but much higher-grade ore than originally contemplated."

New Westminster.—The future of markets affecting nickel production in British Columbia would appear to be assured following the receipt by Giant Nickel Mines, Ltd., of an attractive proposal from Sumitomo Shoji Kaisha, Ltd., for all output from the Giant (formerly B.C. Nickel and Pacific Nickel) Nickel mine, near Hope. The company is at present shipping 50 tons daily of nickel concentrate grading 14% nickel and 4.5% copper to the Sherritt Gordon refinery at Fort Saskatchewan. The contract covers only 8,000 tons; therefore, the management, if the Japanese proposal is accepted, would commence shipments to the Orient at the beginning of 1960. Giant Nickel Mines, Ltd., was formed this year when Giant Mascot Mines, Ltd., purchased the interest of Newmont Mining Corporation of Canada, Ltd., in Western Nickel, Ltd. The new operating company is owned 51% by Giant Mascot and 49% by Pacific Nickel Mines, Ltd.

Lillooet.—During the second quarter of 1959 the Bralorne division of Bralorne Pioneer Mines, Ltd., produced 27,037 oz. of gold from 36,406 tons of ore, averaging 0.743 oz. in gold per ton. At the same time the Pioneer division produced 8,899 oz. of gold from 19,440 tons grading 0.458 oz. per ton. At a valuation of \$35 per oz. the value of the combined output would be \$1,257,760. Development of the "77" vein continued on the 34 and 35 levels of the Bralorne mine during the quarter. On the 34 level a further 480 ft. of driving brought total length to date to 765 ft. grading 1.16 oz. gold per ton over an average width of 7.0 ft. At the lower horizon grade has tended to be lower; 400 ft. of driving in the quarter assayed 0.56 oz. per ton over 6.6 ft., bringing the developed aggregate to 1,000 ft. of ore grading 0.77 oz. per ton across an average width of 7.0 ft. Deepening of the Queen shaft is being continued and is now nearing the projected 37 level.

Kamloops.—With 721 ft of underground development work done in the East Jersey zone the Bethlehem Copper Corporation, Ltd., has reported an average grade of 1.27% copper for that zone; exploratory drilling from surface had indicated a grade of 0.95% for the same block. Underground work is also being done in the bigger Jersey zone.

Nicola.—Shareholders of Craigmont Mines, Ltd., have been advised by Mr. E. P. Chapman, the consulting geologist, that the underground development of the Craigmont mine is rapidly changing the definition of ore reserves from "qualified" to "proven". He states the deposit is amenable to exploitation by large-scale, low-cost mining methods; that metallurgical characteristics are excellent with a high percentage of recovery obtainable without fine grinding; that geological conditions are favourable to the discovery of additional ore, and that a substantial portion of the iron in the predominantly copper ore can be economically recovered if a satisfactory market can be found for the product.

Peel Resources, Ltd., has announced that it is to proceed at once with diamond drilling following favourable results of geochemical, magnetometer, and spontaneous polarization surveys of its property

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near the Craigmont mine. The work has indicated anomalies with higher-than-average intensity.

Similkameen.—Consolidated revenue of the Granby Mining Co., Ltd., and its wholly-owned subsidiary, in Phoenix Copper Co., Ltd., for the first half of 1959 was \$533,446; the net profit was \$120,635, equivalent to 26.4 cents per share. Phoenix Copper, which commenced production in mid-April, earned an operating profit of \$63,340 after treatment of 48,066 tons of ore to the end of June. A programme of modernization and improvement is being started at the Allenby foundry to provide for the manufacture of a wider range of products to be offered in a much broader market.

Greenwood.—West-Coast Resources, Ltd., has been incorporated to acquire all the holdings of Consolidated Ventures, Ltd., in the Greenwood area. An airborne geophysical survey is to be conducted at once by Lundberg Explorations, Ltd., of all the properties held by Mr. W. E. McArthur, Sr., who has optioned them to West-Coast. The company holds full title to a 48-claim block surrounding the Copper Queen and King Solomon claims, key producers in the earlier history of the area. The company is capitalized at 5,000,000 shares (50 cents par value), of which 900,000 shares have been issued for properties.

Slocan.—All work was suspended by Western Exploration Co., Ltd., at the end of June, the final phase having been driving in the Mammoth ore zone at depth. Previously mining had been discontinued in the Minoru-Hecla mine following extraction of the remaining developed ore. Production for the eight months of mill operation in the fiscal year ended April 30, 1959, was 128,794 oz. of silver, 815,660 lb. of lead, and 926,892 lb. of zinc from 7,007 tons of ore assaying 18.4 oz. silver per ton with 5.8% lead and 6.6% zinc; the mill also treated 1,288 tons of custom ore. An overall operating profit of \$6,330 was earned before provision for depletion or depreciation. Proven and indicated ore reserves in the Mammoth, Monarch, and Hecla mines are estimated at 7,084 tons, with an additional 5,300 tons in the Enterprise, 14 miles distant. The balance sheet shows current assets of \$117,661 against current liabilities of \$28,778. Although only 1,875,272 shares of the authorized capital of 3,000,000 shares (50 cents par value) have been issued, shareholders are being asked to approve a resolution to increase the authorized capital to 4,000,000 shares.

New Zealand.—South Pacific Mines, Ltd., has been incorporated in British Columbia to acquire and develop placer and lode properties in New Zealand, principally in the Coromandel Peninsula. These cover old mines and completely unexplored fault blocks in the neighbourhood of Thames and a mine on which one mile of drive on vein has been driven near Maratoto. Options are held on two prospects in the northern part of the peninsula. The placer claims are on the Ohinemuri River and contain a drilled portion estimated to contain 200,000 tons of sand assaying 0.084 oz. of gold and 1.003 oz. of silver per ton. It has been recommended by Dr. A. G. Pentland, consulting engineer, that a cyanide mill be constructed on the placer claims and production commenced as soon as possible. The company is capitalized at 5,000,000 shares (\$1 par value) of which 900,000 shares have been issued for properties and 400,000 shares have been sold for cash.

EASTERN CANADA

August 21.

Gold Production.—The output of the gold mines of Ontario for May included 227,924 oz. of gold and 34,006 oz. of silver, valued at \$7,713,970, from 791,199 tons of ore milled. The June figures included 213,486 oz. of gold and 31,692 oz. of silver, worth \$7,178,823, from 768,725 tons. According to the *Provincial Gold Bulletin* for June Ontario's 30 producing gold mines reported milling 4,671,480 tons of ore for the first six months of 1959, from which was produced 1,331,794 oz. of gold and 194,346 oz. of silver, valued at \$45,237,859. For the same period in 1958 the same mines milled 4,675,262 tons of ore, producing 1,345,182 oz. of gold and 220,777 oz. of silver, valued at \$45,859,408. The daily averages for June, 1959, were 25,624 tons milled, 7,116 oz. of gold and 1,056 oz. of silver produced, having a value of \$239,294. There was an average of 11,119 wage earners, and the average grade of ore was \$9.34.

Porcupine.—A number of celebrations in the Porcupine Camp took place early in July to recognize formally the 50th anniversary of the discovery of gold in the area. In the past 50 years, it has been calculated, the camp has mined some 150,000,000 tons of ore and recovered bullion worth \$1,300,000,000.

Kirkland Lake.—Upper Canada Mines is now mining the higher-grade ore discovered in its deeper levels and the output for the first five months of the current year totalled \$705,543 from 79,900 tons of ore, or an average of \$8.83 per ton. The average recovery in the first five months of 1958 was \$8.35 per ton when production totalled \$679,759 from 81,342 tons.

Manitowadge.—In the six months to June 30 last Geco Mines milled 633,733 tons of ore for an estimated profit of \$2,259,000. A progress report for the period states that the programme for building 60 new houses has made good progress and when they are completed 246 housing units will have been built for employees in the Manitowadge town site. At the end of June the No. 3 Shaft had reached a depth of 1,617 ft. on its way to 2,520 ft. Installation of the new No. 2 primary crusher is up to schedule and should be completed by October, it is stated. The total spent on capital expenditures for housing and shaft sinking amounted to approximately \$615,000 during the period under review.

During 1958, its first full year of production, Willroy Mines, Ltd., milled 330,982 tons of ore grading 1.22% copper, 11.71% zinc, 0.45% lead, and 3.26 oz. silver per ton, which yielded a net smelter return of \$3,190,405. Costs amounted to \$1,745,188, leaving an operating profit of \$1,445,217. The mine produced 68,638,086 lb. of zinc, 6,583,972 lb. of copper, 2,573,027 lb. of lead, 709,726 oz. of silver, and 1,078 oz. of gold in the year.

Northwest Territories.—Development at the Matthews Lake gold property owned by Salmity Consolidated has been resumed, it is stated. The No. 1 Shaft has been re-opened preparatory to driving at the 125-ft. level.

In the area of Rankin Inlet, 320 miles north of Churchill, Manitoba, a new company, Arctic Explorations, Ltd., is to conduct an intensive survey for economic minerals. It will be based on the property of North Rankin Nickel Mines, Ltd., which is participating in the venture.

Manitoba.—The Bernic Lake mine, some 30 miles north-east of Lac du Bonnet, is being rehabilitated. Montgomery Explorations, Ltd., expects that shipments of lithium and caesium minerals will soon be under way.

Quebec.—Aluminium, Ltd., reports a consolidated net income of \$10,570,000 for the six months period ended June 30, as compared with \$10,451,000 in the corresponding period of 1958. The Aluminium Co. of Canada, Ltd., whose accounts are consolidated with those of the parent company, reports a six months net income, before payment of preferred dividends, of \$5,604,053, as compared with \$9,954,666 in the first six months of 1958. Aluminium, Ltd.'s, consolidated sales of all products increased to \$184,593,000 from \$174,625,000 in the first half of 1958, while operating revenues from transportation and other services declined to \$27,555,000 from \$33,333,000 a year ago. In his message to shareholders, Mr. Nathanael V. Davis, the president of Aluminium, Ltd., states: "Consolidated sales of aluminium in all forms and from all sources were 172,000 tons in the second quarter of 1959, compared with 124,000 tons in the first quarter, and 150,000 tons in the second quarter of last year. Six months' sales in 1959 were 296,000 tons compared to 278,000 tons in 1958. Average sales prices of aluminium were lower in 1959 than in 1958. . . . Under the difficult world shipping conditions obtaining this year, opening of Saguenay river navigation in April was followed by a reduction in shipping losses in the second quarter compared with the first, as reflected in the improved relationship between operating revenues and operating expenses. This more than offset the impact on net income of adverse movements in exchange rates."

AUSTRALIA

August 20.

Uranium.—Commenting on a report by the United Kingdom Atomic Energy Authority that there would be an over-supply of uranium in the world until the 1960's, the Minister for National Development said that Australian uranium producers were protected against a difficult market situation until about the mid-1960's, by when the world demand will be developed for uranium for new power stations. The Australian Atomic Energy Commission considers that although a rather difficult period lies in the years immediately ahead the long-term prospect leaves no doubt. The United Uranium Company has reported the discovery of a new lode in its Coronation Hill mine, showing pitchblende freely. This company is the most recent producer in Australia. In its latest progress report the company had treated 2,304 tons of ore with a head value of 9.05 lb. uranium oxide per ton.

Hitherto the Government has restricted export of uranium to Great Britain and the United States. The Minister for National Development has recently announced that the restriction will be eased to countries that need small quantities of uranium oxide for chemical analysis and test work and quantities totalling 2,500 lb. of uranium oxide will be exportable to any one country. Approval has been given for the export of a small quantity to

Japan, strictly for testing, and for sampling for peaceful purposes. An export licence under the new policy has been issued to Mary Kathleen Uranium, Ltd., for the sample shipment to Japan.

Western Australia.—Recent company reports show the general position of Western Australian gold mining in a period when industrial and wages conditions were stable, although the recent increase of 15s. per week in the Federal Basic Wage will be felt in the current period. As there is no compensating increase in the price of gold the operating results of the gold-mining as well as other mining companies will be adversely affected.

Central Norseman Gold Corporation reported record gold production with a corresponding rise in profit of 14.8% to a new peak of £A759,303 in the year to March 18. The dividend was raised by 3d. per share to 3s. 6d. per share, after a steady 3s. per share for five years. In the 1958-59 period the mill treated 190,157 tons of ore for the recovery of 109,801 fine oz. of gold, as compared with the previous year's figures of 172,195 tons and 95,722 oz.; average recovery was 11.55 dwt. compared with 11.12 dwt. per ton. Ore reserves at the end of the period were estimated at 592,000 tons against a previous estimate of 584,000 tons; grade was the same in both periods—9.2 dwt. The proportion of payable development footage on the shears was 23% compared with 48% for the Mararoa and Crown Reefs and 32% against the previous 19% for the Princess Royal Reef.

Lake View and Star in the period March 18 to June 30, 1959, treated 215,420 short tons of ore and re-treated 252,954 short tons of tailings for the recovery of 49,143 fine oz. of gold. In the corresponding period of 1958 211,510 tons of ore and 246,370 tons of tailings were treated for the recovery of 47,948 oz. of gold; estimated mining surpluses in the respective periods were £Stg. 429,666 and £Stg. 425,117. Lake View and Star has been replacing the steam-driven winding plant at Chaffers shaft by electric power and the change over will be made without interruption to production. The work has been carried out over a period of 12 months at an ultimate cost of £A280,000, of which £A202,000 has been already spent. The electrification practically eliminates the company's firewood costs, previously a heavy item. The new winder will operate 7-ton skips and will hoist in two shifts the same quantity of ore as was previously raised by the steam winder in three shifts. Maximum hoisting capacity is 200 tons per hour from the upper levels; drums are 14 ft. diameter and the engine is of 915 h.p. The new steel headframe is 113 ft. high. The old steam winder was built by Fraser and Chalmers and during its life hoisted 11,000,000 tons of ore.

Gold mines of Kalgoorlie preliminary figures for the year ended March 31, 1959, show a profit of £A248,686, a decrease of £A60,791 compared with the previous year. This was the combined effect of a reduction of income and an increase in costs caused largely by the subsidence in the Boulder Perseverance mine. The net profit in the previous year was £A309,477.

Great Western Consolidated wrote off £A458,700 for development redemption and reported a loss of £A119,520, whereas in the previous year operations resulted in a profit of £A51,850, after writing off £A268,910. There were difficulties in sinking the internal shaft in the Copperhead mine resulting in heavy expense and delay. As a result little ore was

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**The Broken
Hill Mines.**

(Australian News and
Information Bureau.)

added to reserves below No. 16 level and development charges increased from 10s. to 19-2s. per ton. Ore reserves are estimated at 667,000 tons compared with the previous total of 937,000 tons. The mill treated 477,947 tons of ore and sands and recovered 81,115 oz. of gold; in the previous year the figures were 535,201 tons of ore for 78,446 oz. of gold. The proportion of underground ore rose from 62% to 75% which caused an increase in working costs. Recovered grade increased by 0.46 dwt. to 3.39 dwt.

Western Mining Corporation, which is the parent company of a group and is a holding and exploratory organization, has made a preliminary announcement for the year ended March 31, 1959, of a net profit of £A308,444. In the previous financial year profit was £A259,970.

The Morning Star mine, operated by Gold Mines of Australia, a sister company to Western Mining Corporation, has a long history and is one of the few mines worked in Victoria in recent years. The company has decided to discontinue development and diamond drilling, mine the remaining ore, withdraw underground machinery, and close down. In the past three years 6,800 ft. of development work and 8,600 ft. of diamond drilling have been completed between Nos. 19 and 24 levels. Five minor ore-bodies were located and have been worked out. The chance of finding a major ore-body in this part of the mine has been eliminated by the development carried out. The company has paid dividends amounting to £A495,000.

Opal Mining.—This may be regarded as almost an Australian industry and has characterized the arid parts of western New South Wales, northern South Australia, and, to a lesser extent, southwestern Queensland. Hitherto it has been an industry of individual effort. There has been greatly increased interest in recent months, notably in the United States, and this has been stimulated by large finds at the Andamooka opal field. There is a change in mining method from slow, careful, traditional hand work to large-scale working by

earth-moving equipment, a change in practice that could result in the destruction of valuable gem stone. The productive opal-bearing horizon has a depth of about 40 ft. generally, but opal occurs at deeper levels.

Tasmanian Iron Ore.—Tasmania still adheres to the idea of a State-owned iron and steel industry and drilling has been in progress for some time at the Savage River, in the north-west of the island. There is a large iron-ore deposit in this region, but although the State authorities are optimistic of the outcome of the exploration strong doubt is expressed as to whether this, and collective iron-ore deposits in the island, will aggregate the tonnage necessary for such an enterprise. Metallurgical work carried out on the ore has indicated that it is not suitable for direct smelting and that beneficiation would be an essential stage in the enterprise. Transport will be a serious factor with the Savage River area and still more so if other deposits should be worked in conjunction. The drilling plant is to be moved to Long Plains, an area which is held under lease by Rio Tinto Australian Exploration, Ltd., to investigate a deposit located during an aerial survey. Work is to be concentrated in the Savage River—Long Plains locality to determine whether sufficient ore is available to warrant the setting up of an iron and steel industry. Should this not be the case the alternative would be export to the mainland steelworks and this outlet would be faced by difficult and costly transport.

Antimony.—Antimony mining has been a more or less precarious branch of the industry in Australia in the hands of working parties and individuals and a few small companies, which have usually been short-lived. The largest present-time operator is New England Antimony Mines, N.L., in northern New South Wales. Financial results have been irregular, but recent reports show that work over the past year has been profitable and ore reserves have been improved. Occurrences are not large and are usually irregular. The Tariff Board

has inquired into the production of antimony, antimony ores, and concentrates, but decision has not yet been reached. In the past year the mine produced 1,145 tons of concentrates from the milling of 7,449 tons of ore.

Peko Copper Mine.—This mine is the Northern Territory's copper mine and is the highest-grade copper occurrence being worked in Australia. The mine is situated at Tennant Creek, Northern Territory, and as combined circumstances are unfavourable to local smelting the mine is burdened by high transport charges to the smelter, a distance of approximately 2,000 miles, or nearly 1,000 miles to a port from which overseas export could be effected. There is speculation as to whether the expanded operations of Mount Isa Mines, in Queensland, would afford smelting facilities, but this would necessitate 400 miles of road transport from mine to smelter and a further 600 miles for transport of metal from smelter to refinery and port. In the last financial year there was a decrease of 20% in profit, at £A104,392, resulting from a fall in production. The value of production, plus the copper bounty, totalled £A1,036,728. The mill treated 117,569 tons of ore for the production of concentrates containing 6,516 tons of copper, 13,056 oz. of gold, and 36,189 oz. of silver. Mill feed averaged 6.11% copper, as compared with 7.38% in the previous year.

Electrolytic Zinc Co.—This company has carried out major modernization at the West Coast zinc-lead mines at Rosebery, which has increased productive capacity by 25%, but at the present time production will remain restricted by the existing world oversupply. The company's present annual output is about 200,000 tons of ore. The major work completed at Rosebery includes a storage bin of 4,000 tons capacity to hold crushed ore. A new hoist is being installed to haul ore through the incline shaft from the lower levels to the adit level equipped with electric traction and connecting with the mill. The company's exploratory work has been very successful both at the Rosebery and the Hercules mines and these results may be expected to continue.

Mount Bischoff.—It appears that a new effort is to be made to explore the old Mount Bischoff tin mine on the west coast of Tasmania. In its active years Mount Bischoff was the largest and most important tin mine in the world, worked mainly as an open-cut proposition, but gradual depletion of the superficial ore occurrences brought about the closure of the great mine, as efforts to locate underground ore occurrences of commercial importance were unsuccessful. In later years there was a campaign by the Federal and State Governments for deeper exploration, but without success. The Tasmanian Government has now announced that approval has been given to Rio Tinto Australian Exploration, Ltd., to explore the abandoned mine. An effort is to be made to locate deeper ore-bodies.

Coal.—The Commonwealth Government has set up an expert committee to inquire into additional uses for coal and Western Australia is included in its scope. The type of investigation suitable to Western Australia's conditions and problems has yet to be decided. The State's commercial coalfield is Collie, in the south-west, where reserves have been computed at 1,877,000,000 tons. Considerable extension in tonnage has been proved and indicated by exploratory work in recent years.

FAR EAST

August 10.

Dredges for Malaya.—In a leaflet recently issued in London in connexion with a display regarding Malaya's mineral resources reference is made to the few new dredges installed since the war. Recent designs, it is pointed out, embody many improvements, including the method of control for the bucket and winch drives, automatic lubrication wherever possible, and pneumatic control for operating the winches from a control room so situated that the operator could see the working conditions. In addition tin saving plants have also been made more efficient by dewatering the feed and improving the jiggling arrangements so as to assist in the recovery of fine tin, it was stated. The amount of tin-bearing ground in Malaya is not inexhaustible and, as properties of medium depth became worked out, the necessity arises of developing new fields of greater depth.

Some dredges have been reconstructed to increase their effective dredging depth by lowering the paddock water by pumping. Such dredges are equipped with silt wheels and stackers at the stern which enable tailings to be discharged 50 ft. or more above the water level. This, in many cases, is more economical than the provision of new deep-digging dredges. Nevertheless, dredges capable of working at great depth below water level are still a necessity in cases where it is impossible to lower the paddock water to any great extent.

Hong Kong.—The annual report for 1958 states that in the year there was mining of iron, lead, wolfram, and graphite by underground methods, while kaolin, clay, quartz, and feldspar were worked by open-cast methods. Iron ore and kaolin were exported to Japan, lead ore to the United Kingdom and Europe, wolfram to the United Kingdom and the United States, and graphite to the United States and Formosa. Kaolin was also used locally by manufacturers of rubber goods, while quartz and feldspar were solely produced for local consumption, principally by the enamelware, ceramic, and glass-making industries. All mining leases and licences and prospecting licences issued were for the New Territories—i.e., the mainland and the islands of Lantau, Chek Lap Kok, West Brother, Ma Wan, and Tsing Yi—and operations were mainly controlled by individuals or by small Chinese mining companies. At the close of the year there were five mining leases, 23 mining licences, and two prospecting licences in operation.

In 1958 production from the Ma On Shan iron mine was almost entirely from underground sources. The ore was treated in the 700-ton-a-day dressing plant, situated near the waterfront, and concentrates were transported by barge to ships anchored in Tolo harbour. The continued low market price for wolfram discouraged general interest in the mining of this mineral and the Needle Hill mine was responsible for all production for the year. Prospecting for beryl, graphite, and iron ore was undertaken in 1958, but there was no discovery of economic importance.

The colony's production of minerals for the year was as follows: Feldspar, 1,653 long tons, worth \$(H.K.)\$57,862; graphite, 3,285 long tons, worth \$341,619; iron ore, 105,125 long tons, worth \$3,994,755; kaolin, 7,621 long tons, worth \$685,866; lead ore, 36 long tons, worth \$14,791;

quartz, 4,484 long tons, worth \$89,686, and wolfram, 38 long tons, worth \$299,803.

The Mines Department was under the control of the Commissioner of Labour in his capacity as Commissioner of Mines and was under the immediate direction of a superintendent of mines, who was assisted by two assistant inspectors of mines. Ownership and control of all minerals was vested in the Crown under the Mining Ordinance, 1954. This ordinance also provided for the issue by the Commissioner of Mines of prospecting licences and of mining licences. It also provided for the Land Officer to issue mining leases for periods of up to 21 years.

Japanese Uranium.—It was recently reported in Singapore that Japan has succeeded in producing pure uranium for the first time, at the Atomic Fuel Corporation's refining plant at Tokamura, in Ibaragi prefecture. Meanwhile, a three-year programme of prospecting for uranium deposits over an area of 80,000 square kilometres in Japan is nearing completion. As a result of the prospecting carried out thus far it has been determined that the Ningyo-toge mine, located on the border between Tottori and Okayama prefectures, contains the richest deposit of uranium resources. It was discovered by a car-borne surveying team and estimates have put its uranium-ore deposits at about 1,500,000 tons. Other major sources of uranium include the Kurayoshi mine in Tottori prefecture and the Iwai and Nodatamagawa mines in Iwate prefecture.

The work of surveying and prospecting has been carried on in the following four stages: (1) Discovery of radioactive areas by air-borne or car-borne methods; (2) concentrated survey of radioactive areas detected; (3) securing of necessary basic data to determine the economic value of such uranium deposits, and (4) digging of pits and physical and geochemical surveys and research needed for drafting of development plans. These activities have been carried out by the Ministry of International Trade and Industry's Geological Research Institute and the Atomic Fuel Corporation as well as private enterprises with the co-operation of other public organizations and universities. At the same time the Government has been granting subsidies to private bodies engaged in prospecting for uranium deposits and in the manufacture of necessary equipment.

As for smelting of uranium ore, research has been pushed ahead by private institutions and state-operated laboratories and a test plant for the development of smelting technology is expected to be completed by the end of the year by the Atomic Fuel Corporation.

Iron Ore in Pakistan.—More information is available about the largest known reserves of high-grade iron ore in Pakistan, located in the mountainous Dammer Nissar area, in the south-western part of Chitral State in West Pakistan. The deposits are accessible only by traversing rough steep trails over the 10,024-ft. Lowarai Pass, which is snowbound six months in the year, and occur at altitudes ranging from 4,850 ft. to 7,000 ft. above sea-level. The same types of rock as are found in south-western Chitral occur within Dir State, to the south-east of the Lowarai Pass and old records suggest that useful deposits of iron ore are to be found within this territory. Should this prove to be the case transportation problems would probably be much reduced as it would be unnecessary to

cross the Lowarai Pass. To date geological surveys in Dir State have not been permitted, but it is hoped that such can be arranged in the near future.

In the Dammer Nissar area, in the southern part of Chitral State, east of the River Kunar and near the eastern boundary of Afghanistan, extensive occurrences of magnetite have been reported. Dammer Nissar Fort, a well-known landmark of this area, is about 20 miles south of Drosh and is connected by a fair-weather road with Mirkhani, which is on the road between Drosh and the Lowarai Pass, 10,024 ft. above sea-level. Four groups of closely-spaced lens-shaped bodies of magnetite are present in the area, two in the drainage area of Seri Gol and called Seri Gol East and Seri Gol West deposits. Several lenses north of the Seri Gol deposits are known as the Dammer Gol deposits and lenses north-west of the Seri Gol deposits as the Biryala deposits. Seri Gol East is the most promising deposit, being fairly large and rich in iron content. Next in order of preference are the Dammer Gol West deposits. The deposits are found on steep slopes the altitude ranging from 4,850 ft. to 5,100 ft. above sea-level in the Seri Gol localities. The other deposits, which are three to four miles south-east of Dammer Nissar Fort, are at altitudes of 5,000 ft. to 7,000 ft. above sea-level and 2,000 ft. to 3,000 ft. above the fort.

JOHANNESBURG

August 25.

Reserve Bank.—At the recent annual meeting of the South African Reserve Bank the Governor, Dr. M. H. de Kock, commented that in South Africa the 1957-58 year had probably not yet felt the full impact of the world recession in raw material or primary product prices and of contraction in its export markets. The effects were however more marked in the 1958-59 year and the rate of growth in general economic activity declined further. The real national income probably showed little or no increase. Soft spots have become noticeable in the base-mineral industry, farming, and certain sections of secondary industry and commerce, but other sections, particularly gold-mining, reflected substantial expansion. However, a general cumulative recession has been avoided and recent indications have been definite in showing that the downward trend in the rate of economic growth has been arrested. Exports have improved and the gold output continued to improve. Levelling off or an increase have been noted for imports, building plans passed, value of property transactions, value of retail sales, and discounts and advances of commercial banks. Two factors in the avoidance of a general recession have been the gold output increase and continued high level of State expenditure, on balance reflected in an improved balance of payments position and level of gold and exchange reserves. The Governor stated that the high level of Government expenditure has not significantly slowed down the economic tempo in the past two years. However, the Governor submits that in the long run private investment must be relied upon as the basic pacemaker of the economy and that Government and local authority expenditure should come to represent a smaller proportion than at present as soon as private investment shows concrete

evidence of a revival and of a need for finance. The indications are that the funds for such investment are available or are becoming increasingly available. Concerning the immediate outlook, indications are that the stage is now set for a recovery, if indeed it has not already begun.

In this connexion the Minister of Finance has recently noted that the recession overseas, which reached South African shores later than those of most overseas countries, has apparently been arrested and, according to most comment, should now be reversed. However, toning down "back-to-the-boom" statements, the Minister has pledged adequate Governmental contribution to the re-creation of favourable conditions for expansion of the economy without incurring the risk of inflation. The overall programme, initiated last year, embraces increased State purchases from domestic industrial producers, especially from the textile and engineering industries at reasonable prices, greater spending by local authorities, more positive protection of internal industries, according the farming industry greater assistance directly and through the Land Bank. How far the programme would revive competitive conditions in the labour ranks, especially native labour, has not been commented upon, but the tone of the Minister's and other statements suggests that the programme would not materially affect the complement available for mining, particularly gold. Nevertheless, with memories still fresh of the struggle of the gold mines to obtain adequate enrolment of native labour in the boom period, the trends of recruiting will doubtless be carefully watched, particularly if there is any strong revival in the markets for raw materials, such as would detract from recruiting in the territories to the north. The Minister pointed to the fact that capital for the expansion programme was available. Certainly at the moment the relevant institutions appear to have adequate cash resources for investment.

Returns for the balance of trade in the first half of 1959 reflected a marked improvement on those for 1958. Imports were reduced to £243,457,000 from £304,012,000, while exports firmed up to £203,539,000 from £201,873,000, the adverse trade balance being reduced to £39,918,000 from £102,139,000.

Shaft Guides.—A division of the Council for Scientific and Industrial Research is conducting tests into the use of free-hanging rope-guides for shafts in a specially constructed model shaft, 12 in. in diameter and 150 ft. deep, mainly with a view to preventing collision of the skips or cages, arising from swaying of the ropes as a result of aerodynamic forces. The results will be applied to one of the shafts soon to be sunk by one of the mining companies. Operations are being fully simulated in the model, including ventilation air-flow.

Southern Africa.—An Economic Survey Mission has been appointed to conduct a general survey of the requirements and natural resources of the Basutoland, Swaziland, and Bechuanaland Protectorates. It will make recommendations on the application of financial resources that exist or might be made available for development. The Mission has been appointed in consultation with the International Bank of Reconstruction and Development. The chairman is Professor C. Morse, of Cornell University, U.S.A.; other members are Sir G. Hadow, Brigadier C. G. Hawes, Mr. N. Lees, and Professor J. F. C. Phillips.

A feature of the 1958 mining operations in

Swaziland was the considerable increase in the production and sales of diaspore, which is supplied to a West German concern, and of pyrophyllite, which is sold to South Africa. Sales of the former rose to 940 short tons at £4,493 from 252 tons at £1,127; of the latter to 156 tons at £555 from 22 tons at £85. Sales of chrysotile asbestos, the main production of the Protectorate's mining, declined to 25,261 short tons at £2,130,952 from 30,727 tons at £2,437,917 in 1957, due to market conditions. In addition to the work of the Geological Survey and Mines Department, both Central Mining Finance, Ltd., and the Johannesburg Consolidated Investment Co., Ltd., have been active in advancing coal exploration further. The stage has been reached where it is apparent that the territory is richly endowed with coal deposits of grades ranging from anthracite to low-volatile bituminous coals. Promising chrysotile asbestos deposits have been exposed in pits and by drilling in the Mbabane district, but further work is necessary for more accurate description and assessment. Further exploratory work is being undertaken by Johannesburg Consolidated Investment on the cinnabar occurrence in the Pigg's Peak district. The same company is also prospecting on a fluorspar deposit in the Hlatikulu district. Greater interest is indicated in the gold deposits and the Department obviously feels that further interest is fully justified despite the refractory nature of much of the ore. The Swaziland Iron Ore Development Co., with which the Anglo American Corporation is a major associate, continues its active exploration on iron-ore deposits in the Mbabane district and plans to apply for a prospecting permit over adjacent siderite deposits. Mapping will be followed by drilling. Perlite occurrences are also being investigated in the Hlatikulu district.

Gold Output.—Table 1 shows the recent trend in regional milling, gold output, and yield per ton in the first six months of 1959 and 1958, with the latter in brackets. Despite improvements in the

Table 1

Region.	Tons milled.	Gold output (oz.).	Yield per ton—dwt.
Eastern Transvaal . . .	436,000 (Nil)	105,872 (Nil)	4.857 (Nil)
Witwatersrand . . .	21,277,600 (21,244,300)	3,798,522 (3,745,325)	3.57 (3.526)
Far West . . .	3,176,000 (Libanon-Doornfontein)	1,522,030 (1,325,036)	9.585 (9.157)
Klerksdorp . . .	3,586,000 (3,110,000)	1,443,599 (1,213,828)	8.051 (7.806)
Free State . . .	6,113,000 (4,993,500)	2,591,842 (2,046,580)	8.48 (8.197)
	34,588,600 (32,241,800)	9,461,871 (8,330,769)	5.471 (5.169)

second quarter of 1959, working costs per ton in respect of gold operations were reduced in 15 instances and rose in 37 instances, while costs per ounce were reduced in 25 and rose in 27 instances, compared with the first half of 1958. In the latter period costs per ton were reduced in 16, rose in 36 instances, and were unchanged in one instance.

Uranium Profits.—Table 2 sets out a comparative assessment of the levels of working profits on uranium and gold-uranium operations for the second and first quarters, 1959, and the estimated levels of profits on the basis of grade and costs in the same two quarters and of a selling price of 57s. per lb. of uranium oxide, such as may obtain in the post-

contract period. The tabulation does not take into account any variations in grade and costs that may be effected in the post-contract period when, of course, loan and interest payments will not have to be provided for. The inclusions of the loan and interest quarterly instalments gives an indication of the relative levels of disposable profits in the contract period after deducting the loan and interest instalments, compared with the estimated working profit on the basis of 57s. a lb. of uranium oxide.

Table 2

Mine.	Present working profit.		Estimated working profit at 57s. a lb.	
	Per lb. U ₃ O ₈ .*	Per ton milled**.	Per lb. U ₃ O ₈ .*	Per ton milled**.
Afrikaner Lease	45.7	17.88*	24.8	1.50 L
	(42.99)	(17.02)**	(20.51)	(4.00) L
Daggafontein	50.85	29.38	23.6	24.05
	(52.61)	(31.6)	(26.49)	(26.23)
Vaal Reefs	60.37	78.33	40.72	67.95
	(58.39)	(84.84)	(37.44)	(72.34)
Western Reefs	50.19	36.53	21.74	24.72
	(49.04)	(38.35)	(19.35)	(17.96)
President Brand	46.08	149.21	16.13	145.23
	(47.13)	(137.37)	(17.07)	(131.63)
President Steyn	51.75	49.60	17.78	42.27
	(50.83)	(52.31)	(18.36)	(44.27)
Welkom	52.72	27.45	19.91	20.46
	(52.17)	(28.46)	(19.06)	(21.19)
Harmony†	56.33	61.34	33.25	49.95
	(58.18)	(62.32)	(33.43)	(48.71)
Blyvooruitzicht	50.58	114.36	29.25	104.06
	(52.19)	(119.61)	(26.50)	(106.97)
Doomfontein	52.77	45.29	19.77	42.32
	(54.72)	(43.56)	(8.78)	(39.10)
West Driefontein	54.96	159.14	24.60	154.38
	(64.55)	(163.51)	(16.68)	(155.30)
Luipaards Vlei	76.11	14.96	48.30	0.04
	(73.32)	(15.03)	(46.6)	(1.764)
Vogeltruisbult	60.16	19.04	11.77	10.58
	(59.82)	(20.15)	(6.22)	(10.50)
Hartebeestfontein	61.41	131.53	41.08	111.53
	(58.83)	(131.61)	(39.83)	(112.31)
Virginia	54.50	23.41	25.75	11.58
	(55.91)	(28.29)	(28.48)	(15.36)
Loraine	46.58	3.31	12.33	3.20 L
	(42.59)	(4.08)	(15.17)	(1.96) L
Freddies Consolidated	51.07	4.10	26.29	3.97 L
	(50.32)	(3.41)	(25.26)	(4.80) L
Randfontein	N. A.	16.88	N. A.	16.26 L
	(N. A.)	(18.03)	(N. A.)	(13.89) L
East Champ	N. A.	12.92	N. A.	14.54 L
	(N. A.)	(13.10)	(N. A.)	(9.84) L
Dominion Reefs	52.75	39.04	29.68	16.94
	(53.08)	(34.18)	(30.20)	(12.30)
Ellaton	33.76	29.20	1.61 L	17.79
	(38.31)	(32.78)	(6.59)	(22.04)
Buffelsfontein	60.10	65.61	37.91	54.79
	(57.77)	(61.08)	(35.93)	(50.16)
Stilfontein	47.5	66.8	16.9	60.74
	(50.88)	(76.16)	(24.14)	(70.23)
West Rand Consolidated.	64.91	19.53	48.16	11.42
	(64.78)	(20.0)	(47.17)	(11.61)

* After allowing for treatment or extraction costs only, in the uranium plants, deducted from uranium revenue.

** After allowing for mining and treatment costs in respect of both gold and uranium, deducted from gold and uranium revenue.

† Includes pyrites.

L. Loss.

(All values are in shillings.)

Transvaal.—In its No. 5 sub-vertical shaft West Driefontein Gold Mining obtained a complete exposure of Carbon Leader Reef around the periphery with average values of 290.8 dwt. over a channel width of 9.1 in. or 2,646 in.-dwt., which is considerably higher than the average reef disclosures in development further north to date. The intersection was made at a depth of about 6,300 ft. below surface and 993 ft. below the collar on 18 Level. While the values in the sub-vertical shaft intersection cannot be generally accepted as representative of the overall average to be obtained at depth, they confirm expectations that values will tend to increase with depth. It has also been the expecta-

tion that values will decline eastwards, which up to the No. 3 Shaft area has actually been realized. Taking the high-grade section from the western boundary to the No. 3 Shaft area over the full width of the mine, the indicated average reef values may be 1,100 in.-dwt. or about 26 dwt. over 42 in., disregarding the section east of No. 3 Shaft. The mine has already initiated development on the shallower Ventersdorp Contact Reef horizon from the No. 5 Shaft—that is, in the south-western section, where payable values over 260 ft., have averaged 370 in.-dwt. Mining policy in respect of the treatment of ore from the Ventersdorp Contact Reef has not yet been stated. The diluent effect of such lower-grade ore on the mill grade therefore cannot be estimated. However, in respect of both West Driefontein and Western Deep Levels, the indications of the shaft values from No. 5 sub-vertical are very favourable.

Following on the use of vacuum-moulded concrete buntons in some of the Free State mine shafts (particularly those of the Anglo-Transvaal group) because of their aerodynamic efficiency in relation to the ventilation air-flow and more particularly, it seems, because of the resistance to the corrosive action of the underground water of the field, it has been reported that mainly because of their aerodynamic efficiency relative to the ventilation flow Western Deep Levels are installing hollow, rounded steel buntons of oval section in its shafts, designed by Mr. D. M. Bentley, a consulting engineer of the Anglo American group.

Orange Free State.—In the vicinity of the proposed site for its new 22-ft. diameter shaft in the south-west section of the mine, the bore-hole drilled by Free State Geduld Mines to obtain information that will determine the depth of that shaft has intersected the Basal Reef at 4,400 ft. with values of 197 dwt. over 5.28 in. or 1,040.2 in.-dwt. Results of two deflections are awaited. The bore-hole, about 4,300 ft. south of the No. 1 Shaft, is sited in a position interesting in so far as it lies between the zone of great enrichment recently reported, being a little more than 1,000 ft. east of the last-known point reached by 47 Level drives and some 2,000 ft. south of 45 Level drives, and Geduld No. 1 bore-hole about 5,200 ft. to the west. Initially, the proposed shaft will be divided into a downcast ventilation section for hoisting and an upcast ventilation section. The site is well south of the major faulted and water-zone which extends east-west below the No. 1 and 2 Shafts. The depth of the Basal Reef is progressively shallower south of the No. 1 Shaft. Until the results of the two deflections are known, comparison with results already announced may be deficient. To the north of the bore-hole being deflected, 585 ft. sampled averaged 8,093 in.-dwt. The lease area can be divided into two sections: The high-grade section, south of the No. 1 and 2 Shafts, has an indicated grade of about 45 dwt. over 46 in. or about 2,070 in.-dwt., which may be adjusted according to the extent of the very grade zones recently announced. This high-grade section is about 17% of the lease area of about 6,600 claims. The lower-grade section is north of the same two shafts and has an indicated grade of about 5.75 dwt. over 46 in. or 264.5 in.-dwt. On the basis of the bore-hole results and development results so far announced it is possible to arrive at a grade-range from about 16 dwt. to 29 dwt. over 46 in.

In No. 2 Shaft of Free State Geduld bakelitized

wooden pipes or ducting is being installed in place of conventional galvanized duct in an attempt to counter the corrosive water of the goldfield. The smooth bakelite finish reduces friction and is a protective against mould growth. The two ventilation columns consist of 48 in. and 60 in. diameter piping.

Central African Federation.—Begun in 1947 and more recently including the opening-up of the Nchanga and Chingola open-pit mines, the programme of expansion by Nchanga Consolidated Copper Mines has virtually been completed. Unless further expansion of a major nature is decided upon, capital expenditure from 1960 will be at relatively low levels. The company, which has achieved great flexibility in plant and mining operations, is continuing prospecting work in the Chingola and Mimbula ore-bodies and has unwatered the Riverlode for revaluation with a view to further prospecting. This work is expected to add considerably to the calculated ore reserves. Metallurgical research is being conducted for the recovery of copper from banded sandstones lying above the main ore-body. If a fully successful method can be evolved large tonnages of low-grade ore can be drawn for treatment from current and old workings, as well as the Nchanga open-pit without further major expenditure on development.

South-West Africa.—It has been reported that Trans-American Mining Corporation, Ltd., of Canada has initiated its programme of oil exploration in the Luderitz-Conception Bay zone and that an aerial magnetometric survey is in progress. Rights ceded to the above company are subject to an 8% royalty on gross returns to Diamond Mining and Utility Co. (S.W.A.), Ltd.

Letters to the Editor

The Witwatersrand Mineralization

Sir,—I have not replied previously to Prof. Davidson's letter (1)¹ for reasons which are explained later. That letter is a mass of inaccuracies but that is comparatively unimportant compared with the fact that in all his publications on the hydrothermal origin of the gold in the bankets he gives no geological data of the bankets, their wall rocks, dykes, small and large faults, etc. Furthermore he has not, as far as I am aware, anywhere compared the detailed geology of hydrothermal gold-quartz veins and the bankets. His knowledge of the literature of the bankets and hydrothermal bankets, as well as alluvial gold, is, I suggest, quite inadequate to back up his vehement views. Dr. Davidson writes brilliantly and it is a matter of great regret that his facts are so few and his assumptions so erroneous. For

¹ Figures in parentheses refer to the list of references given at the end of this letter.

example he remarks (1): *Fourth, he (the writer) is endemically blind to the hydrothermal zoning that can be discerned in the Witwatersrand if one has the eyes to look for it.*

I take it that Dr. Davidson came to this conclusion because my letter bore a Johannesburg address. In fact I wrote it from the Konongo gold mine, in Ghana, but as I was due to return to South Africa I gave my Johannesburg postal address. The Konongo mine is a gold-quartz mineralization of undoubted hydrothermal origin and I had been working on that mineralization at the time of writing my letter for over eight months. This is yet another instance of single-factor correlation and no matter how true the Johannesburg address it is still a matter of poor scientific method. For the past seven years I have not worked in the Union of South Africa professionally and have only visited it on leave. Until May this year I had not been underground in a Witwatersrand mine for 20 years, my time having been spent on ore deposits in the Bushveld Complex, hydrothermal gold, tin, and copper deposits, those of metamorphic origin such as asbestos and talc, and on sedimentary rocks. Much of my research work, as could have been seen from my publications, has been on the geology and geochemistry of underground water. In 1938–1940 I did some research work on the bankets and associated rocks in connexion with mine dusts and also on the petrography of the rocks in conjunction with a colleague who was working on diamond drilling. In 1951 I did some research on the bankets in connexion with the distribution of gold in the bankets and wall rocks, as well as pyrite. I examined borehole cores and hand specimens, in thin and polished section, and was struck during the course of the investigation by the lack of wall-rock alteration and mineralization. This, *plus* my not inextensive research work on hydrothermal mineralizations, lead me to criticise Dr. Davidson's hypothesis of hydrothermal mineralization of the bankets. My work on copper and other deposits in the Murchison Range, gold in the Barberton, and parts of Southern Rhodesian hydrothermal deposits, gave me the necessary background to approach the banket *not as a placerist* but in fact as a hydrothermalist. Although I was a student of the late R. B. Young, and in my younger days inclined to the hydrothermal theory, I have always had a very open mind on the

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subject of hydrothermal origin. In 1956 and 1957 I spent over a year in the field examining and prospecting uranium-columbium rare-earth mineralizations of hydrothermal and granitization origin in Southern Nyasaland.

In 1953 Dr. Davidson said (2) :

While the writer has made a specialized study of most of the accessible uranium deposits of the world, his knowledge of the Witwatersrand, based upon little more than half a dozen inspections underground and on a quite inadequate reading of the extensive literature, is altogether too slender to form a basis of constructive theorization.

In a later contribution (3) he does not mention further work in the Witwatersrand mines. As he, as far as I am aware, has nowhere published geological sections of the bankets underground showing wall-rock alteration, which as he remarks can be seen if one has the necessary will to see it, I take it that he has not done any more work in the field on the Witwatersrand System. This is most important as Dr. Davidson maintains (2) :

Third, he sees a sharp cut-off of the mineralization at the foot-walls and hanging-walls of the reefs which is non-existent when the values are viewed in the broad light of sedimentary geochemistry instead of the narrow beam of economics.

Elsewhere (3) he states :

It seems probable that a "trace" of gold determined in the routine work of a mine assay office 25 years ago represents a significant measurable quantity to the academic geochemist and Macadam's work perhaps suggests, not that the quartzites are "almost" devoid of gold (a turn of phrase conditioned by commercial values) but that these rocks contain more gold and pyrite than would be found in any sequence of "normal" strata.

In routine mine assays it is usual to take a weight of sample of one assay ton—that is, 29.17 g.—for the determination and if the bead in the cupel cannot be weighed then it is reported as a trace. An ore of 1 dwt. of gold means that there is one part per 560,000 by weight of gold—that is, 0.00017%. A trace of gold is usually taken as less than 0.2 dwt. per ton, so that a trace means an amount less than 0.000034%. In routine assaying crucibles are used over and over again and there may be contamination from the crusher so that some Assay Offices never report gold "Nil" but report it as a trace, although it may well be beyond the sensitivity of the method for one assay ton. Dr. Davidson has therefore not correctly interpreted the significance of a "trace" and Macadam's conclusion is quite justified. The amount of

pyrite reported by Macadam was in percentages so that his values need no re-interpretation in the light of geochemistry.

With regard to the cut-off of the mineralization I have given figures elsewhere (4) that show that Dr. Davidson has not correctly interpreted the phenomena of hydrothermal alteration. For example Junner (5) in his description of the Bibiani mine, in Ghana, p. 26, says

Pyrite and arsenopyrite . . . constitute about 4-5 per cent. by weight of the average ore. They are more common in the mineralized schists and the wall rocks adjacent to the quartz reefs than they are in the reefs. . . .

Hirst (6) in his description of the Konongo gold mine, Ghana, says

The wall rocks were silicified, with the development of biotite and carbonate, and impregnated with arsenopyrite, pyrite, subsidiary pyrrhotite, and a little chalcopyrite. Sulphides were also deposited to a less extent in the fissures along with the quartz and most of the gold, though gold also occurs in the wall rocks near the reefs.

I have shown that in fact the wall rocks may contain more gold than the reef. In one case I re-sampled a quartz reef which had been proved to be not very promising because the sampling had been confined to the quartz, whereas the best values were found in the phyllites of the wall rocks. I could quote numerous cases, not only for gold, but also for copper, where the wall rocks have been heavily impregnated by the solutions bringing up the metals and metalloids.

I have now in 1959 spent over 60 shifts underground in a Central Witwatersrand mine, not inspectional visits, but on the examination, detailed sampling and plotting of hundreds of feet of face of the Banded Pyritic Quartzites, Main Reef Leader (and some Main Reef) and the South Reef. I have carefully looked for wall-rock mineralization, but cannot find any trace of it except in one or two cases, where dykes or sills have intruded and some pyrite has been developed, but this has been found to contain little or no gold. I have examined the Main Reef Leader from a depth of 2,300 ft. down to over 9,000 ft. in this mine but cannot find any evidence of depth zoning—as shown by increasing amounts of pyrite, dropping of gold values, increased tourmaline, increased wall-rock alteration, and so on. It is significant that until I brought up wall-rock alteration and depth zoning no mention has been made of it in the literature, or I cannot trace it. In view of its importance I feel that Dr.

Davidson should not hesitate to publish his data of wall-rock alteration and depth and lateral zoning. He mentions a forthcoming contribution; well, less discussion and more data on these points would be of great value, particularly as most of the older mines would welcome any unexploited sources of gold which they have missed by adhering to the placer theory.

Prof. Davidson has raised many more points, but I shall not deal with them here, I want only to take up his point about the introduction of magnesia into the Transvaal dolomite and the lack of feeding channels. The late Dr. R. B. Young asked me to assist him in the field and in the laboratory when he was doing his work on the dolomites and subsequently I did more research on my own, chiefly from a chemical point of view. I am not aware that anyone has ever entertained the idea that the magnesia was introduced into the dolomite hydrothermally; in fact the very consistent nature of the dolomite chemically over very large areas and over thicknesses exceeding 4,000 ft., the presence of chert layers of great thicknesses, and many other factors, all negative such an idea. In my work I felt that the dolomite was either deposited chemically or bio-chemically as a magnesium limestone or else after deposition magnesia was taken up from the waters of the environment. No matter what view is held, however, a hydrothermal origin at a date when the full thickness had been developed is unreasonable and, as far as I am aware, not based on any field or laboratory evidence. Yet that is what Dr. Davidson suggests in making his comparison with the Witwatersrand Bankets. Horwood (9) felt that it could not be an original chemical precipitate but nowhere suggests a hydrothermal origin.

As regards a connexion of the mineralization with the contemporary granites, whatever that means, no field mapping can be shown to prove such a connexion at all and all the dykes that I have ever seen underground are not related to granites in any way.

In due course I intend to publish papers on the geology of uranium and related deposits, as well as of the Witwatersrand, and I will then discuss the question of radioactive dating more fully. In the meanwhile I suggest that geology is essentially a subject to be studied in the field or mine and that Dr. Davidson might study and compare hydrothermal deposits of gold in the Transvaal and Southern Rhodesia, and

perhaps Ghana, and compare these with the bankets. The geology of the Michigan copper ores cannot be relevant except on general principles. In particular I suggest that not only he, but also Ramdohr, study Junner's work on the alluvial gold of Ghana. On p. 68 Junner states (7):

Incidentally some of the river gravels, e.g. the Ankobra, contain relatively as much pyrite as the Rand Banket. The pyrite which occurs partly as sharp-edged crystals and partly as water-worn crystals assays a few dwt. of gold per ton.

On the same page he says of the Ankobra and Tano gold that the bulk of this is sharply angular or very slightly water-worn.

I agree with Dr. Davidson in his criticism of Ramdohr's use of the term "pebble" (8). Ramdohr's pebbles are about 300 microns and his nodules about 130 microns. There is no consistency in his description of what nodules and pebbles are. To use the term "pebble" for a minute rounded grain of 100 to 150 microns, some are indeed smaller, whether for pyrite, uraninite, or other mineral is generally misleading but even more so in the case of the banket where true pebbles of 4 to 5 cm. diameter are common (often as much as 10 cm. in the case of the Main Reef Leader) and grits and small pebble bands of 5,000 to 10,000 microns. Although he does not mention the size on p. 32 of his latest work Ramdohr talks of rounded grains of chromite and he remarks that in primary deposits this mineral occurs as rounded grains. I support Dr. Davidson on this point and have published this elsewhere (4). I shall deal with it at a later date in my geological notes of the uranium minerals of Southern Nyasaland.

V. L. BOSAZZA.

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- (2) DAVIDSON, C. F. (1953). "The Gold-Uranium Ores of the Witwatersrand." THE MINING MAGAZINE, 88.
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- (4) BOSAZZA, V. L. (1958). The Occurrence of Uranium in Ancient Conglomerates." *Econ. Geol.*, 54.
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(8) RAMDOHR, P. (1957). "New Observations on the Ores of the Witwatersrand in South Africa and their Genetic Significance." *Geol. Soc. S. Afr. Ann.* to Vol. LXI.

(9) HORWOOD, C. B. (1905). "The Dolomite Formation of the Transvaal, Johannesburg." Parktown, Johannesburg, July 26, 1959.

Sir,—I commend to Dr. Bosazza's attention a war-time telegram from Winston Churchill to H.M. Minister in Kabul: "Clarity and cogency can, I am sure, be

reconciled with greater brevity." In keeping with this injunction, perhaps I need do no more than assure him that my promised contribution (the completion of which, to my regret, has been unduly delayed) will be replete with data on the several deposits to which he refers.

C. F. DAVIDSON.

ST. ANDREWS,

SCOTLAND.

September 4, 1959.

Trade

Notes

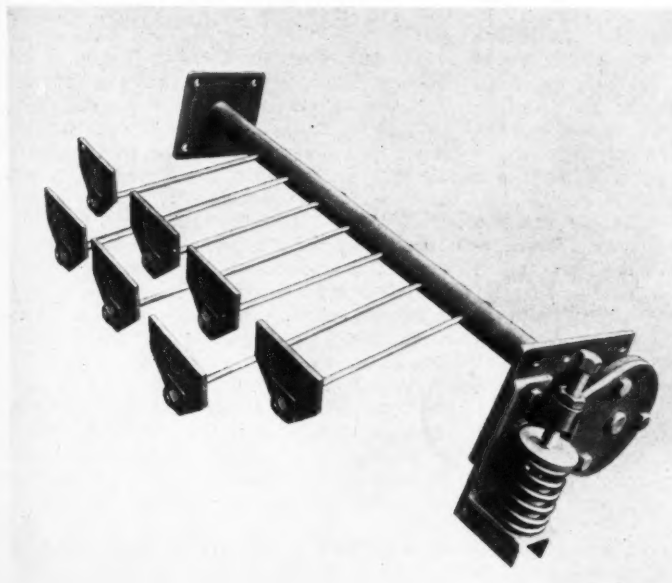
Brief descriptions of
developments of
interest to the
mining engineer

Multi-Blade Conveyor Scraper

An important consideration in obtaining good belt life in a conveyor is the maintenance of clean driving conditions and there are some materials which are difficult to remove from a belt and which tend to build up on the driving drums and elsewhere to the detriment

of mechanical efficiency. Belt distortion and more rapid wear may also be a consequence. To meet this **Richard Sutcliffe, Ltd.**, of Horbury, Wakefield, have designed a multi-blade scraper as illustrated, which they believe to be an improvement on the scraper of the counter-weighted single-blade type.

On this new device each blade is mounted



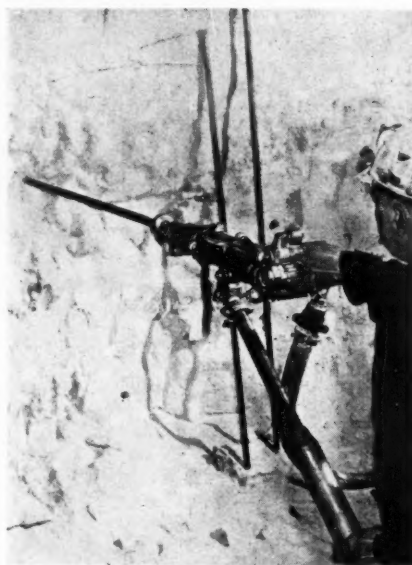
**Sutcliffe
Conveyor-Belt
Scraper.**

on a separate spring-steel bar, which allows it to wear individually according to the amount of work it does. In this way no part of the belt is left unscraped and cleaning efficiency is improved. The blades are 5 in. to 6 in. wide and wear-resistant rubber to a height of 2 in. is bonded on to each leading face. The blade is supported under the belt at right angles to the carrying surface by a spring-steel bar parallel to the centre line of the conveyor and carried at the opposite end by a cross shaft mounted in brackets on the side frames and carried by a spring-loaded torsion bar.

Two sets of blades may be ranged across the width of the conveyor by mounting the spring-steel bars at a pitch slightly greater than the width of each blade, using alternate bars of different lengths. In this way the belt is scraped twice at each pass. The rubber scraping edge and the steel blade wear down simultaneously, the wear rate of the rubber being less than for scrapers with steel edges or Squeegee rubber strips. The scraper is mounted so that the blades trail from the cross shaft and this prevents snagging by fasteners or projecting edges of torn belts. Inner and outer blades are interchangeable and are simple to remove.

Rock-Drills

In the June and July issues of the *MAGAZINE* mention was made of the newly-formed Air Power Division of **Joy-Sullivan, Ltd.**, at 7, Harley Street, London, W. 1 and to machines that have become available from British manufacture. Among these are a range of "Speedline" rock-drills comprising the L.37, a hand-held drill of 35 lb., the L.47 also hand-held but of 50 lb. for heavier duty, and the JAL.47 which is the same with air-leg mounting. A feature of all three which is stressed by the makers is the dual valve, providing positive air control on both up and down piston strokes. Attention is also drawn to the use of cadmium plating and to aid this provides to normal lubrication and the fact that it permits less tolerances between piston and cylinder wall. The rated capacity of the L.37 is 8 ft., but this can be deeper in easier going. The drill is undemanding on air requirements; where the air supply is limited to a 160 or 315 c.f.m. compressor, two to six L.37 drills can be operated. The hand-held L.47 goes down to



10 ft. and can drill easily to 14 ft. in favourable conditions. The illustration shows the JAL.47 drill in use.

Mining Machinery Manufacturers' Export Association

Recently formed in Great Britain is the Mining Machinery Manufacturers' Export Association, a body which, it is felt, can prove helpful to those firms which have for too long been dependent on the coal industry alone as a market for their products. It was announced on September 2 that Powell Duffryn, Ltd., have agreed to release Mr. D. G. Hemmant, the managing director of their international consultancy organization, Powell Duffryn Technical Services, Ltd., for a period of up to a year to take up the appointment of acting director of the Association. Mr. Hemmant has resigned his directorship of Powell Duffryn Technical Services and his full-time services for the period are to be directed towards developing the Association in its early stages. His temporary release from his duties with Powell Duffryn has been made by the parent company in the full recognition of the potential importance of the Association in developing mining machinery exports, it is stated.

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Next President of the Institution

It was announced last month that Professor David Williams, who occupies the University of London chair of mining geology at the Imperial College of Science and Technology, has been elected President of the Institution of Mining and Metallurgy for 1960-61. Elected to Associate Membership in 1932 and to full Membership in 1941, Dr. Williams has served on the Council since 1949, holding office as Vice-President from 1954 to 1957.

Following service in the first world war, Professor Williams entered the University of Liverpool in 1918, gaining honours degrees in civil engineering in 1921 and in geology in 1922. In the following year he was awarded the M.Sc. in geology and in 1926 the degree of Ph.D. (Liverpool) and the Diploma of the Imperial College for his geological researches in Snowdonia.

Joining the late Mr. A. Broughton Edge in 1926 he spent two seasons in Northern Rhodesia mainly on geophysical prospecting, then after a few months' exploration work for the Tigon Mining Corporation in Almeria, Spain, he was engaged as mining geologist at the Rio Tinto mines until 1932.

Professor Williams began his teaching career at Imperial College in 1932 as lecturer in geology, initially with special reference to applied geophysics, becoming Reader in 1947 and finally professor of mining geology and head of the Department of Geology in 1950. At the end of September he relinquishes the office of Dean of the Royal School of Mines after serving continuously in that capacity since January, 1952.

He has travelled widely on geological missions and his advice as a consulting geologist has been sought by various companies and official organizations, while he still retains his association with Rio Tinto.

Professor Williams has also given long service to the Geological Society of London as a Member of Council and Vice-President, including nine years as secretary, and was awarded the Lyell Medal of the Society in April of this year. He is now Centenary President of the Geologists' Association for 1958-60, and previously served for several years on the Council of the Mineralogical Society and as a Regional Vice-President of the Society of Economic Geologists.

The president-elect, who is well known for his many professional publications in pure and applied geology, will take office in May, 1960, in succession to Dr. J. H. Watson.

Personal

A. C. J. ANDERSON is home from Nigeria.

L. E. ANTONIDES has been appointed mining engineer to the Associated Metal and Minerals Corporation, of New York.

M. G. M. ATMORE, of the Anglo American group, has been seconded to the South African Atomic Energy Board as its chief metallurgist to assist in planning and organizing improvements in the methods of recovering and up-grading uranium oxide.

R. L. BLANDY has returned from Northern Rhodesia.

P. H. BRAY is now in Uganda.

A. W. CLARK is here from Liberia.

E. L. DEMPSTER is now in South Africa.

L. E. DJINGHEUZIAN has been awarded the Leonard gold medal of the Engineering Institute of Canada.

E. F. ELKAN has been appointed a director of West Vlakfontein Gold Mining.

H. F. FROMMURZE, assistant director of the Geological Survey of the Department of Mines in South Africa, has retired after 38 years of Government service.

W. GIBSON is home from Sierra Leone.

N. W. GRIFFIN is returning from Malaya.

L. A. HILL is now in Uganda.

R. A. MACKAY returned last month from work in Italy and Iran and is now on a visit to Canada and the United States.

G. C. NORMAN is now in Portugal.

G. F. OATS is now in Northern Rhodesia.

J. F. PHILPOTT is returning from Ghana.

G. C. REYNOLDS is home from Ghana.

G. W. THOMAS is returning from the Philippines.

WILLIAM BERNARD BLYTH, who died on August 21, left the Royal School of Mines in 1910 and until 1916 worked mainly in oil, first in Egypt and then in the West Indies. In 1916 he returned to this country to join the Forces, serving in France with the Royal Engineers, in which the war Mr. Blyth was again engaged in oilfield development, both in Europe and the West Indies. Formerly an Associate of the Institution of Mining and Metallurgy he had for many years been active in business in London.

THOMAS MICHAEL FOLEY, who died in hospital on August 5, aged 58, was trained at the Royal College of Science, Dublin, and Camborne School of Mines. Leaving Camborne in 1923 Mr. Foley worked in the Sudan until 1934, largely on his own account, and then spent the following six years in Egypt, partly in Government Service. During the war he served with the Royal Engineers, in which he attained the rank of Lieutenant-Colonel. Formerly an Associate Member of the Institution of Mining and Metallurgy, Mr. Foley had of recent years been working in Nigeria.

INSTITUTION OF MINING AND METALLURGY

Elections and Transfers

Member.—Jean Joseph DANJOY (*La Frette, France*).

Associate Member to Member.—Arthur Clifford Joslin ANDERSON, A.R.S.M., E.P. (*Jos*); John

Rowlls Delves Broughton, A.C.S.M. (*Springs*); Willis Patrick Brunton, A.C.S.M. (*Bihar*); Colin Blaine Campbell, B.Sc., A.R.S.M. (*London*); Alastair Francis Dickson, A.R.S.M. (*Susurluk, Turkey*); George Falkner Hunt, B.Sc., E.M. (*Lairobi*); Joseph Lindsay McCluggage, B.Sc., A.C.S.M. (*Taiping*); Donald Francis Munro, A.R.S.M., B.Sc. (*Que Que*); Derek Anthony Temple, A.R.S.M., Ph.D. (*Bristol*); Bryan Antony Tregay, A.C.S.M. (*Broken Hill, N. Rhodesia*).

Associate Member.—Robert Henry Alloney, B.Sc. (*Newcastle-on-Tyne*); Nicolas Charalambides (*Nicosia*); Jeremy Frank Collinge Fisher, B.Sc. (*Kitwe*); Kenneth Alan Gilbert, A.C.S.M. (*Bancroft, N. Rhodesia*); Philip John Goldsmith (*Quebec*); Jolyon Edward Peter Halse, B.A., B.Sc. (*Kitwe*); James William Lambert (*Sheffield*); Leslie Dyne Muller, B.Sc. (*Didcot*); Arthur Harold John Todd, B.A. (*Purley*); Peter Henry Williams, A.R.S.M., B.Sc. (*Kalalushi*); Stanley Edmund Worthy (*Mpanda, Tanganyika*).

Student to Associate Member.—Kenneth Ernest Sylvester Applin, A.C.S.M. (*Segbuenia*); George William Thorold Barnett, B.Sc., A.R.T.C. (*Hanwood*); Henry Francis Coates, A.C.S.M. (*Kuala Lumpur*); Terence Frederick Lanz (*Mufulira*); Hans Robert Morris, M.A.Sc. (*Noranda*); Tadeusz Moskwa (*Nkana*); Daniel Olisankwe Obiogo, A.C.S.M. (*Jos*); John Edward Philpott, B.Sc. (*Akwatia*); Geoffrey Victor Strong (*Jos*); William Addison Willox (*St. Albans*).

Affiliate.—Newby Alexander Tatham (*Salisbury, S. Rhodesia*); Kenneth Thompson (*Nicosia*).

Student.—Clive Raymond Charlton, A.C.S.M. (*Camborne*); Wing-Hong Cheong (*Camborne*); Trem Rosser Edwards, A.C.S.M., B.A. (*Birmingham*); Reginald John Jackett-Simpson, B.Sc. (*Camborne*); Carl Donald Tyndale Watson-Gandy (*Edinburgh*); James Colin Wilkinson, B.Sc. (*Durham*).

Metal Markets

During August¹

Copper.—The long-threatened strike by United States copper workers began at the very end of July and gathered momentum in the first few days of August as labour was withdrawn from more and more plants. With many consumers closed down, or nearly so, because of the peak holiday period and demand for the metal thus very low, the copper market was almost completely dominated by the news from America. In the first week of the month prices crept up steadily,² but there was a general feeling that the strike would have to be really widespread and last for some time to affect the supply position sufficiently to cause any sharp change. Then, on August 10, with Phelps Dodge's Laurel Hill refinery closed and a strong chance that Kennecott's properties would be affected, prices rose from £228 to £235 a ton. They remained in the £230-plus range for more than a week after that, except for the afternoon price for August 17 which fell back to £227 on rumours (which later proved unfounded) that one major producer—Anaconda—

had agreed to abide by the terms of any settlement reached with the unions by any other American producer. Then, at the beginning of the fourth week of the month, prices began to slip back a few pounds as consumers in Europe remembered the fundamental over-supply position that has been such a feature of the copper market for so long.

The Copper Institute's latest figures for producers' stocks, announced at about that time, also helped to allay any fears about future supplies that consumers might have had at the backs of their minds, showing as they did that world stocks at the end of July were the highest since August, 1958, and American stocks the highest since October last. On August 26 the decline in prices even went so far as to become a distinct sag, prices falling as low as £228, but the following day there were rumours of yet a further extension of the labour troubles to Chile and the market recovered markedly with prices shooting back to £235. The month closed with the metal fetching £237 a ton and a brisk American demand for European copper developing.

Copper consumption in the United Kingdom in June was 56,112 tons. Production of refined copper amounted to 10,856 tons of primary metal and 8,810 tons of secondary. Stocks of refined copper totalled 70,945 tons and blister copper stocks closed at 10,532 tons.

Tin.—The marked stability that tin prices have exhibited for some time on the London Metal Exchange held good throughout August.¹ At no time in the month did the settlement fall below £792 10s. and at its highest it was only £795. The insulating effect of the Buffer Stock control system against such outside influences as the continuing United States steel strike remained the dominant feature of an otherwise featureless market. Indeed, it was, of course, largely on account of the Buffer Stock control system that the market was so featureless. The supply position was somewhat tight in the early half of the month and there was a backwardation in open-market prices in the second week, which widened temporarily to £3 a ton before the demand for spot metal slackened slightly.

Towards the end of the month interest was centred largely on the meeting of the International Tin Council scheduled for the first week of September. The ruling question in tin trading circles then was the possibility of an adjustment in export quotas for the fourth and final quarter. That there would be some increase in such quotas was generally regarded as probable, but there was considerable uncertainty as to its probable extent—largely because no one had any precise notion as to how much tin was actually held in the Buffer Stock at the time, though there was also some uncertainty as to what sort of policy was likely to be followed with regard to the liquidation of the remaining tonnage.

Consumption of tin in the U.K. in June was 1,987 tons, against 1,686 tons in May. Production amounted to 2,267 tons and stocks were up on those at May 31, at 9,683 tons.

Lead.—The lead market, which closed on a note of uncertainty at the end of July, had quite a good tone in the first week of August,¹ despite holiday quietness, although this was perhaps due more to an absence of selling pressure rather than to any definite improvement in the supply/demand relationship. Current month prices improved by about £1 over the course of the following week, in which

¹ Recent prices, pp. 88, 128.

² See Table, p. 128.

¹ See Table, p. 128.

trading was carried out on quite a substantial scale. This same rate of improvement held throughout the third week of the month and into the fourth week without increasing appreciably, even though the threat to production at the American Smelting and Refining Co.'s plants in the United States—which later materialized—hung over the market. When the strike began on August 24 the U.S. domestic lead price was raised by 1 cent per lb. to 13 cents. However, while it was known that United States import quotas would prevent America from taking any appreciable quantities of material from outside sources to satisfy consumer demand until after the mineworker's strike, some surprise was felt when prices in London slipped back from £72 15s. on August 25 to £71 15s. on August 26 and £71 12s. 6d. on August 27. With U.K. consumer demand fairly good and reasonably steadily maintained, prices rose again later and subsequently closed the month around the £72 mark.

U.K. lead consumption in June amounted to 30,099 tons. Stocks on June 30 totalled 57,810 tons, of which 47,185 tons were imported and the remaining 10,625 tons were English refined lead.

Zinc.—The zinc market maintained its good undertone throughout the month¹ and prices rose overall by about £4 a ton. Consumer demand remained at a reasonably good level and supplies were not over-plentiful. Indeed, there is every indication that the world supply position is tightening gradually and thus it is being increasingly thought in trade circles that supply restrictions imposed by producers earlier in the year may be relaxed before many more months pass.

U.K. zinc production was 7,437 tons in June compared with 5,938 tons in May. Consumption amounted to 30,221 tons.

Aluminium.—As for some months past, the aluminium market was very quiet in August and Canadian metal was still being quoted at £180 a ton. There was a certain amount of speculation during the month, however, as to how long secondary aluminium ingot prices could be maintained in view of the fact that the Canadians are nowadays offering high-grade virgin alloys at prices that are low in relation to U.K. secondary alloy ingots. The latter are themselves already very competitively placed in relation to scrap prices, and sales competition must put pressure on scrap buying prices.

Another item of more than casual interest was the announcement at the end of the month that Kaiser Aluminium had appointed a resident sales agent in London. This means that two of the "big three" United States producers are now directly represented in the United Kingdom and there is speculation as to how long the Aluminum Company of America will be content to attempt to make sales here from its offices in New York and Pittsburgh.

Antimony.—Antimony consumption in the U.K. in the first half of the year, according to figures released in August, amounted to 2,282 tons, against 2,511 tons in the same period of 1958. Consumption of antimony in scrap was up in the same period at 2,299 tons against 2,250 in the first half of 1958. There was no change in the market situation in August and English regulus is still priced at £197 10s. a ton delivered for 99.6% material.

Arsenic.—There have been no developments regarding arsenic recently and the price is still £400 a ton.

Bismuth.—Quiet trading was again a feature of the month. Bismuth is currently quoted at 16s. a lb.

Cobalt.—In the U.S.A. the African Metals Corporation reduced its f.o.b. New York price for extra-fine metal powder from \$2.70 per lb. to \$2.57. In the United Kingdom there was no change in the price of 14s. a lb., but one trade publication has begun recording the fact that buyers on a contract basis can obtain metal at 12s. 6d. per lb. This is the figure that compares with the majority of cobalt prices published overseas.

Cadmium.—U.K. consumption continues to maintain an upward trend, according to figures released in August for the first half of the year. They show that over 100 tons more was used in the first half of this year than in the corresponding period of 1958. The price remains unchanged at 9s. a lb.

Chromium.—Chromium metal is again quoted at 6s. 11d. to 7s. 4d. per lb.

Tantalum.—The price of tantalite improved in July to 650s. to 700s. a unit and it has remained at that price since. Occasional demand from Europe at good prices continues to give a useful measure of support.

Platinum.—Overall demand for platinum, which has been patchy for some time, remained so in August and there was no strong market trend in any direction. U.K. and Empire platinum continue to fetch £28 10s. per troy oz., while imported metal is still quoted at £26 10s. to £27 10s. an oz.

Iridium.—Quite a number of the minor metals exhibited little or no price change in August, which is hardly surprising since consumers were generally affected by holiday considerations and their normal demands are only comparatively small. Iridium was such a metal, trading being very quiet during the month, and its price is still £24 to £26 15s. per troy oz.

Palladium.—Palladium, like iridium, was in little demand during August and it is again quoted at £7 5s. per troy oz.

Osmium.—The price is still £23 to £32 5s. per troy oz.

Tellurium.—Tellurium lump and powder is now quoted at 18s. a lb. and tellurium sticks at 20s. The basic difference between Canada and the United States as to whether the present plentiful supply of tellurium or its long-term possibilities for increased consumption should influence current prices seems to have been settled in favour of the latter view. Prices on the American market have advanced in recent months and the metal's potential in certain compounds—notably bismuth telluride—is given as a reason for adopting a bullish attitude to the future.

Tungsten.—The tungsten ore market improved considerably during August and the general feeling among traders at the end of the month was that the rise in prices experienced continually since the peak holiday period would be maintained for some little time. Actual transactions became fewer towards the end of the month, but as supplies were short and consumers still obviously interested merchants were confident of renewed inquiries in the near future. Consequently, they tended to buy up as much material as was available for their own stocks. The net result of all this was to keep the price rising so that on August 31 the quotation reached 102s. 6d. to 107s. 6d.

Nickel.—Trading in nickel in August was much the same as in recent months and the price remained unaltered at £600 a ton. The U.S. Government

¹ See Table, p. 128.

sprang something of a surprise during the month when it announced through its General Services Administration that it was to be relieved of all its existing obligations to purchase nickel for stockpiling purposes from the International Nickel Co. of Canada. Under an agreement with the Government, Inco has agreed to cancel all remaining deliveries of nickel under its "market price" (74 cents per lb.) contract. Nickel still to be delivered under the company's premium price contract will be diverted on to the market instead and the U.S. Government will pay Inco the difference between the market price and the premium contract price, in nickel oxide sinter, rather than dollars.

Chrome Ore.—Chrome ore trading in August was again very quiet and current prices for Rhodesian and Turkish material are unaltered at £15 15s. c.i.f. and \$33.50 f.o.b. per ton, respectively.

Molybdenum.—In America the Climax Molybdenum Co. reduced its price for arc-cast pure metal by \$1.85 a lb. Molybdenite is still quoted at 8s. 11d. per lb. of molybdenum contained f.o.b. mine.

Manganese ore.—The c.i.f. quotation is unchanged at 70d. per unit for 46% to 48% material. Following the criticisms of the Indian State Trading Corporation's quota policy as regards manganese ore exports—mentioned in the last report—there have been reports that the Corporation has now booked sufficient orders for the next 12 months to account for over 1,100,000 tons. Whether or not these are firm orders or, as yet, tentative ones is not known but if they are met they should absorb a substantial proportion of India's reduced rate of output.

Iron and Steel.—The U.K. steel industry climbs slowly but surely from the recession. In July, although production was more severely affected by holidays than a year before, the output of steel rose to 320,300 tons a week from 315,900 tons. Pig-iron production, on the other hand, continued to fall, a reflection of the increasing use of scrap, supplies of which are very abundant.

Not all sections of the finishing trade are equally busy, of course, and it is the high rate of operations at the modern strip mills which has been such an important factor in boosting ingot output. The heavy steel trade still lags behind in the general recovery and although there has been some improvement mills producing plates for the shipyards and heavy sections are still working well below capacity.

Overseas interest in British steel, especially tinplate, is enormous. Although there has not been any large renewal of U.S. buying, despite the long strike in that country, some countries normally dependent on American steel seem to have turned to the U.K. among other suppliers. Exports of iron and steel in July rose to the highest for over two years, to reach 292,648 tons, and in a recent four-week period South Wales ports shipped over 50,000 tons of tinplate abroad.

Iron ore.—Although imports rose sharply in June to 1,087,859 tons from 863,431 tons in May, the total for the first six months of the year was only 5,481,230 tons, against 7,054,113 tons in the corresponding period of 1958.

Tin, Copper, Lead, and Zinc Markets

Tin, minimum 99.75%; Copper, electro; Lead, minimum 99.75%; and Zinc, minimum 98%, per ton.

Date	Tin		Copper		Lead		Zinc	
	Settlement	3 Months	Spot	3 Months	Spot	3 Months	Spot	3 Months
	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.	£ s.
Aug. 11	794 0	790 15	235 17½	234 12½	71 6½	72 3½	84 10	83 2½
12	793 0	790 15	234 12½	234 2½	71 7½	72 7½	85 7½	83 15
13	793 0	791 10	236 7½	235 12½	72 8½	73 6½	85 17½	84 13½
14	795 0	792 15	237 17½	236 2½	72 18½	73 18½	86 7½	84 18½
17	793 10	793 5	235 17½	233 17½	73 5	73 18½	86 6½	85 2½
18	793 0	792 15	233 17½	231 17½	73 2½	73 18½	86 16½	85 7½
19	793 0	792 15	234 2½	232 0	72 13½	73 16½	86 12½	85 2½
20	793 0	792 15	234 10	233 2½	73 2½	74 2½	86 7	85 1½
21	793 10	793 5	233 12½	231 12½	73 8½	74 8½	85 17½	84 12½
24	793 0	792 15	231 12½	229 15	72 18½	73 18½	85 0	83 17½
25	792 10	792 5	230 2½	229 5	72 17½	74 0	85 5	84 2½
26	793 0	792 5	228 2½	227 5	71 16½	73 6½	84 18½	83 16½
27	793 0	792 15	235 7½	233 17½	71 13½	73 5	85 11½	84 3½
28	793 0	792 15	235 15	233 12½	71 17½	73 10	85 16½	84 12½
31	792 10	792 5	236 17½	234 7½	72 1½	73 11½	86 17½	84 17½
Sept. 1	792 0	791 15	238 2½	235 12½	72 7½	73 16½	86 12½	85 2½
2	792 10	792 5	237 2½	234 17½	71 12½	73 3½	86 5	85 2½
3	792 10	792 5	235 17½	234 2½	71 17½	72 17½	85 10	84 12½
4	792 0	791 15	235 17½	234 12½	71 17½	73 3½	86 7½	85 3½
7	793 0	792 5	236 17½	235 7½	71 13½	73 1½	86 7½	85 2½
8	793 0	792 5	238 12½	235 12½	71 16½	73 3½	87 2½	86 8½
9	793 10	792 5	236 2½	235 7½	71 17½	73 3½	86 18½	85 6½
10	—	—	—	—	—	—	—	—

Blyvo
Brakp
Bufile
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Crown
Dagga
Doorn
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East C
Easten
Ellato
Freddi
Free S
Gedulu
Govern
Groote
Harmo
Hartel
Libano
Lorain
Luipaap
Mariev
Merrie
Modde
New K
New K
Preside
Preside
Rand I
Randf
Rietfor
Robins
Rose L
St. He
St. He
Simme
S. Afri
S. Roo
Spaarw
Spring
Stilfon
Sub Ni
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Vaal R
Van D
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Village
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Vlakfor
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June, 1
July...
August
Sept.*
Oct....
Nov....
Dec....
Jan., 19
Feb....
Mar....
April...
May....
June...

Statistics

TRANSVAAL AND O.F.S. GOLD OUTPUTS

	JULY		AUG.	
	Treated Tons	Yield Oz.†	Treated Tons	Yield Oz.*
Blyvooruitzicht	135,000	85,735	131,000	84,485
Brakpan	143,000	17,255	14,000	17,180
Buffelsfontein†	144,000	54,521	144,000	54,755
City Deep	121,000	24,931	120,000	24,642
Cons. Main Reef	110,000	19,997	104,000	18,630
Crown Mines	224,000	36,291	224,000	35,234
Daggafontein†	244,000	48,525	244,000	48,479
Doornfontein†	94,000	38,102	95,000	38,580
D'r'n Roodeport Deep	200,000	37,207	200,000	36,556
East Champ D'Or†	12,000	306	12,000	340
East Daggafontein	102,500	17,190	103,000	17,436
East Geduld	147,000	43,370	143,000	42,185
East Rand P.M.	234,000	60,447	227,000	59,722
Eastern Transvaal Consol	19,300	5,933	18,800	6,126
Ellaton†	32,000	7,377	31,500	7,241
Freddies Consol.	63,000	14,445	60,000	14,486
Free State Geduld	88,000	71,584	91,000	74,288
Geduld	76,000	14,936	75,000	14,364
Government G.M. Areas†	55,000	10,875	53,000	10,622
Grootvlei Proprietary	225,000	47,595	225,000	47,269
Harmony Gold Mining	147,000	58,076	140,000	54,964
Hartebeestfontein†	88,000	47,520	91,000	48,685
Libanon	107,000	25,115	110,000	25,709
Lorraine	82,000	15,990	80,000	16,031
Luijpaards Vlei†	125,000	14,378	125,000	14,319
Marievale Consolidated	101,000	24,349	98,000	23,706
Merriespruit†	7,500	1,990	—	—
Modderfontein East	150,000	13,865	139,000	13,603
New Kleinfontein	83,000	10,924	83,000	10,786
New Klerksdorp†	10,500	1,296	10,100	1,111
President Brand	118,000	95,876	120,000	98,195
President Steyn	106,000	40,584	104,000	41,221
Rand Leases	198,000	29,007	196,000	28,910
Randfontein†	218,000	16,265	208,000	15,320
Rietfontein Consolidated	16,000	4,263	16,000	4,308
Robinson Deep	52,000	11,292	53,000	11,077
Rose Deep	44,000	5,339	31,000	5,111
St. Helena Gold Mines	160,000	49,203	160,000	50,002
Simmer and Jack	88,000	16,948	89,000	16,376
S. African Land and Ex.	102,000	21,163	100,000	20,755
S. Roodeport M.R.	31,000	7,295	29,000	7,072
Spaarwater Gold	11,000	3,421	11,000	3,423
Springs	105,000	14,354	104,000	14,333
Stilfontein Gold Mining†	145,000	68,577	150,000	69,934
Sub Nigel	66,500	15,835	66,500	15,824
Transvaal G.M. Estates	7,500	1,990	7,200	1,853
Vaal Reef†	94,000	42,300	95,000	42,750
Van Dyk Consolidated	76,000	14,571	73,000	14,014
Venterspost Gold	131,000	32,337	128,000	32,154
Village Main Reef	27,500	4,626	28,500	4,731
Virginia O.F.S.†	134,000	31,155	134,000	30,987
Vlakfontein	51,000	18,253	52,000	18,564
Vogelstruisbult†	93,000	20,592	90,000	20,063
Welkom Gold Mining	101,000	31,285	100,000	31,170
West Driefontein†	97,000	88,542	99,000	90,688
West Rand Consol.†	223,000	22,950	222,000	22,725
Western Holdings	136,000	82,961	136,000	84,320
Western Reefs	139,000	36,767	139,000	36,765
Winkelhaak	81,000	20,983	80,000	21,009
Witwatersrand Nigel	18,200	4,385	18,200	4,376

† 249s. 1d. * 249s. 2d. ‡ Gold and Uranium.

COST AND PROFIT IN THE UNION

	Tons milled	Yield per ton	Work's cost per ton	Work's profit per ton	Total working profit
		s. d.	s. d.	s. d.	£
June, 1958*	16,435,500	64 9	46 6	18 3	24,358,945
July	—	—	—	—	—
August	—	—	—	—	—
Sept.*	16,760,400	65 10	46 9	19 1	25,633,898
Oct.	—	—	—	—	—
Nov.	—	—	—	—	—
Dec.	16,540,150	67 7	47 10	19 9	25,934,441
Jan., 1959 ..	—	—	—	—	—
Feb.	—	—	—	—	—
Mar.	16,743,500	68 0	45 4	22 8	25,934,881
April	—	—	—	—	—
May	—	—	—	—	—
June	—	—	—	—	—

* 3 Months.

PRODUCTION OF GOLD IN SOUTH AFRICA

	RAND AND O.F.S.	OUTSIDE	TOTAL
	Oz.	Oz.	Oz.
August, 1958	1,463,259	36,413	1,499,672
September	1,465,697	36,799	1,502,496
October	1,516,701	44,025	1,560,726
November	1,484,844	32,349	1,517,193
December	1,480,525	40,372	1,520,896
January, 1959	1,506,670	39,515	1,546,187
February	1,472,090	34,618	1,506,708
March	1,561,196	32,271	1,593,467
April	1,616,891	30,815	1,653,706
May	1,641,990	30,371	1,672,361
June	1,665,503	34,465	1,699,968
July	1,700,968	48,414	1,749,382

NATIVES EMPLOYED IN THE SOUTH AFRICAN MINES

	GOLD MINES	COAL MINES	TOTAL
November 30, 1958	332,443	32,851	365,294
December 31	329,234	32,946	362,180
January 31, 1959	350,656	—	—
February 28	396,217	33,859	430,076
March 31	379,257	32,982	412,239
April 30	383,710	33,081	416,791
May 31	385,278	33,186	418,464
June 30	383,903	33,146	417,049
July 31	381,190	33,295	414,485

MISCELLANEOUS METAL OUTPUTS

	4-Week Period		
	To Aug. 23		
	Tons Ore	Lead Concs. tons	Zinc Concs. tons
Broken Hill South	15,300	2,528	2,806
Electrolytic Zinc	13,798	725	4,155
Lake George	17,346	1,329	2,576
Mount Isa Mines**	58,893	4,100†	2,190
New Broken Hill	41,430	6,131	8,888
North Broken Hill	37,735	7,054	7,466
Zinc Corp.	63,680	10,481	10,530
Rhodesia Broken Hill*	—	—	—

* 3 Mths.

** Copper 2,440 tons.

† Metal.

RHODESIAN GOLD OUTPUTS

	JULY		AUGUST	
	Tons	Oz.	Tons	Oz.
Cam and Motor	32,073	—	32,096	—
Falcon Mines	20,450	3,855	—	—
Globe and Phoenix	6,200	3,164	6,000	3,067
Motapa Gold Mining	15,900	1,110	—	—
Mazoe	3,103	—	2,957	—
Coronation Syndicate	12,006	—	12,248	—
Phoenix Prince*	—	—	—	—

* 3 Months.

WEST AFRICAN GOLD OUTPUTS

	JULY		AUGUST	
	Tons	Oz.	Tons	Oz.
Amalgamated Banket	63,001	15,335	53,200	15,048
Ariston Gold Mines	38,170	13,072	39,920	12,969
Ashanti Goldfields	32,500	27,000	34,000	27,000
Bibiani	33,500	7,200	33,500	7,200
Bremang	—	5,531	—	6,040
Ghana Main Reef	11,927	4,106	11,907	4,145
Konongo	6,600	3,835	6,730	3,785
Lyndhurst	—	—	—	—

PRODUCTION OF GOLD AND SILVER IN RHODESIA

	1958		1959	
	Gold (oz.)	Silver (oz.)	Gold (oz.)	Silver (oz.)
January	44,905	46,553	46,489	18,077
February	43,591	21,313	49,306	19,806
March	43,830	8,179	—	—
April	46,587	22,573	—	—
May	46,015	19,937	46,423	46,280
June	46,453	20,105	—	—
July	44,244	19,170	—	—
August	47,484	20,549	—	—
September	48,295	21,141	—	—
October	46,911	6,342	—	—
November	47,994	16,435	—	—
December	48,888	30,724	—	—

WESTRALIAN GOLD PRODUCTION

	1957	1958	1959
	Oz.	Oz.	Oz.
January	106,722	66,562	63,924
February	64,949	65,965	65,035
March	67,121	65,420	65,408
April	66,435	60,855	62,686
May	64,886	64,196	64,184
June	65,142	67,929	74,590
July	74,420	81,106	78,974
August	75,727	68,610	—
September	64,422	68,744	—
October	64,524	70,128	—
November	65,700	67,562	—
December	66,562	120,106	—
Total	846,610	867,187	—

AUSTRALIAN GOLD OUTPUTS

	4-WEEK PERIOD			
	To JULY 21		To AUG. 18	
	Tons	Oz.	Tons	Oz.
Central Norseman	13,846	7,591	14,225	7,978
Crossus Proprietary	—	—	—	—
Gold Mines of Kalgoolie	39,642	11,755	40,500	11,952
Golden Horse Shoe*	—	—	—	—
Gt. Boulder Gold Mines*	—	—	—	—
Gt. Western Consolidated	32,683	5,579	30,920	6,167
Hill 50*	13,943	6,620	—	—
Kalgoolie Ore Treatment	—	—	—	—
Lake View and Star*	—	—	—	—
Moonlight Wiluna*	—	—	—	—
Morning Star (G.M.A.)	1,633	398	1,654	365
Mount Ida*	—	—	—	—
New Coolgardie	—	—	—	—
North Kalgoolie	28,347	6,697	—	—
Sons of Gwalia	12,278	2,601	—	—
Mount Morgan	—	4,886	—	4,126

* 3 Months

ONTARIO GOLD AND SILVER OUTPUT

	Tons Milled	Gold Oz.	Silver Oz.	Value Canad'n \$
March, 1958	807,458	210,646	35,370	7,248,333
April	785,264	229,361	38,323	7,873,264
May	801,102	228,590	35,712	7,789,644
June	775,384	228,123	37,535	7,745,425
July	750,410	228,960	42,275	7,740,144
August	740,459	218,126	38,940	7,355,406
September	771,115	202,738	31,543	7,006,517
October	801,965	209,006	34,914	7,176,218
November	783,065	230,251	35,097	7,842,435
December	787,573	219,351	30,989	7,490,094
January, 1959	799,178	227,656	41,277	7,700,672
February	727,843	227,981	32,976	7,798,523
March	807,952	223,728	33,045	7,616,425
April	776,583	225,027	32,778	7,712,425
May	791,199	227,924	34,006	7,713,970
June	768,725	213,486	31,692	7,178,823

MISCELLANEOUS GOLD AND SILVER OUTPUTS

	JULY		AUG.	
	Tons	Oz.	Tons	Oz.
British Guiana Cons.	—	—	—	—
Central Victoria Dredging ..	—	—	—	—
Clutha River	—	757	—	706
Emperor Mines (Fiji)*	—	—	—	—
Frontino Gold (Colombia) ..	—	—	—	—
Geita Gold (Tanganyika) ..	—	—	—	—
Harrierville (Aust.)	—	—	—	—
Lampa (Peru)*	—	39,705	—	37,011
Loloma (Fiji)*	—	—	—	—
New Guinea Goldfields	3,895	1,487	—	—
St. John d'el Rey (Brazil) ..	—	—	—	—
Yukon Consol.	—	\$370,000	—	—

* 3 Months. † Oz. Silver: Copper, 82 tons: 85½ tons.

OUTPUTS OF MALAYAN TIN COMPANIES IN LONG TONS OF CONCENTRATES

	JUNE	JULY	AUG.
Ampat Tin	46	38	39
Austral Amalgamated	—	—	—
Ayer Hitam	170	—	—
Batu Selangor	—	—	—
Berjuntai	126	127	130
Chenderiang	—	—	—
Gopeng Consolidated	121*	—	—
Hongkong Tin	494*	—	—
Idris Hydraulic	29*	—	—
Ipoh	51*	—	—
Jelapang Tin	—	—	—
Kampung Lanjut	68	83	43
Kamunting	92	100	109
Kent (F.M.S.)	38*	—	—
Kepong	—	—	—
Killinghall	54*	—	—
Kinta Kelias	—	—	—
Kinta Tin Mines	63½	—	—
Klang River	—	—	—
Kramat	—	7	66
Kuala Kampar	90	80	81
Kuala Lumpur	—	—	—
Kuchai	—	—	—
Lahat Mines	—	—	—
Larut	—	—	—
Lower Perak	51	69	24½
Malayan	290*	—	—
Malaysiam	—	6	8
Pacific Tin Consolidated	—	—	—
Pahang Consolidated	372*	—	—
Pengkalan	62*	—	—
Petaling Tin	204½*	—	—
Puket	—	—	—
Rahman Hydraulic	—	—	—
Rambutan	30*	—	—
Rantau	23½	30½	40
Rawang Concessions	—	—	—
Rawang Tin Fields	—	—	—
Renong	124*	—	—
Selayang	41*	—	—
Siamese Tin Syndicate (Malaya) ..	16	—	42
Southern Kinta	178	135	164½
Southern Malayan	492*	—	—
Southern Tronoh	—	—	—
Sungei Besi	157*	—	—
Sungei Kinta	38*	—	—
Sungei Way	201*	—	—
Taiping Consolidated	20	18	14
Tambah	—	—	—
Tanjong	131*	—	—
Tekka	26*	—	—
Tekka-Taiping	—	—	—
Temoh	13*	—	—
Tongkah Compound	—	—	—
Tongkah Harbour	28	22	33
Tronoh	564*	—	—
Ulu Klang	—	—	—

* 3 Months.

MISCELLANEOUS TIN COMPANIES' OUTPUTS IN LONG TONS OF CONCENTRATES

	JULY		AUG.	
	Tin	Columbite	Tin	Columbite
Amalgamated Tin Mines ..	254	38	226	—
Anglo-Burma Tin *	30	—	32	—
Bangrin	29	—	52	—
Beralit	32	160†	30	160†
Bisichi	35	26	39	34
Ex-Lands Nigeria	38	—	51	—
Geevor	58	—	32	—
Gold and Base Metal	40	7	—	—
Jantar Nigeria	14	23	84	204
Jos Tin	124	—	—	—
Kaduna Prospectors	4	—	4	—
Kaduna Syndicate	13	—	20	—
Katu Tin	12	—	26	—
Keffi Tin	—	—	—	—
London Nigerian Mines ..	—	—	—	—
Mawchi Mines	—	—	—	—
Naraguta Extended	94	—	—	—
Naraguta Karama	5	—	—	—
Naraguta Tin	—	—	—	—
Renong Consolidated	—	—	—	—
Ribon Valley (Nigeria) ..	13	14	—	—
Siamese Tin Syndicate	9	—	74	—
South Bukuru	—	—	—	—
South Crofty	82	—	48	—
Tavoy Tin	—	—	—	—
Tin Fields of Nigeria	—	—	—	—
United Tin Areas of Nigeria	—	—	—	—

* 3 months. † Wolfram.

SOUTH AFRICAN MINERAL OUTPUT

June, 1959

Gold	1,703,050 oz.
Silver	109,069 oz.
Diamonds	226,280 carats.*
Coal	3,373,642 tons.
Copper	(a) — tons in matte and copper-gold concentrates. (b) 4,805 tons of 99.19%.
Tin	197 tons concs.
Platinum (concentrates, etc.)	—
Platinum (crude)	—
Asbestos	15,778 tons.
Chrome Ore	52,957 tons.
Manganese Ore	88,833 tons.
Lead Concs.	— tons.

* May, 1959.

IMPORTS OF ORES, METALS, ETC., INTO UNITED KINGDOM

	MAY	JULY
Iron Ore	863,431	1,204,717
Manganese Ore	25,780	18,946
Iron and Steel	57,455	57,469
Iron Pyrites	9,000	10,654
Copper Metal	37,171	32,953
Tin Ore	3,940	7,648
Tin Metal	28	—
Lead	14,364	26,000
Zinc Ore and Conc.	4,519	13,846
Zinc	12,763	12,765
Tungsten Ores	379	372
Chrome Ore	7,658	18,263
Bauxite	14,576	31,900
Antimony Ore and Concs.	1,000	—
Titanium Ore	28,605	25,633
Nickel Ore	—	—
Tantalite/Columbite	74	33
Sulphur	30,142	34,408
Barytes	2,913	2,227
Asbestos	11,264	13,904
Magnesite	1,749	1,350
Mica	435	967
Graphite	448	128
Mineral Phosphates	103,640	100,626
Molybdenum Ore	538	183
Nickel	43,404	87,112
Aluminium	303,517	301,368
Mercury	93,210	223,442
Bismuth	136,947	173,432
Cadmium	176,148	286,186
Cobalt and Cobalt Alloys	210,702	136,102
Selenium	12,525	181,111
Petroleum Motor Spirit	1,000 gals.	76,671
Crude	980,827	861,902

Prices of Chemicals

The figures given below represent the latest available.

		£	s.	d.
Acetic Acid, Glacial	per ton	106	0	0
" " 80% Technical	"	97	0	0
Alum, Comm.	"	25	0	0
Aluminium Sulphate	"	16	10	0
Ammonia, Anhydrous	per lb.	2	0	0
Ammonium Carbonate	per ton	59	0	0
" Chloride, 98%	"	26	0	0
" Phosphate (Mono- and Di-) ..	"	102	0	0
Antimony Sulphide, golden	per lb.	3	0	0
Arsenic, White, 99/100%	per ton	47	10	0
Barium Carbonate (native), 94% ..	"	Nominal		
" Chloride	"	53	0	0
Barytes (Bleached)	"	20	0	0
Benzene	per gal.	5	2	
Bleaching Powder, 36% Cl.	per ton	30	7	6
Borax	"	46	0	0
Boric Acid, Comm.	"	77	0	0
Calcium Carbide	"	40	17	9
" Chloride, solid, 70/75%	"	13	5	0
Carbolic Acid, crystals	per lb.	1	6	
Carbon Bisulphide	per ton	62	10	0
Chromic Acid (ton lots)	per lb.	2	24	
Citric Acid	per cwt.	11	0	0
Copper Sulphate	per ton	76	0	0
Creosote Oil (f.o.r. in Bulk)	per gal.	1	2	
Cresylic Acid, refined	"	6	10	
Hydrochloric Acid 28° Tw.	per carboy	13	0	
Hydrofluoric Acid, 50/60%	per lb.	1	1	
Iron Sulphate	per ton	3	17	6
Lead, Acetate, white	"	124	0	0
" Nitrate	"	116	0	0
" Oxide, Litharge	"	106	15	0
" Red	"	104	15	0
" White	"	116	15	0
Lime Acetate, brown	"	40	0	0
Magnesite, Calcined	"	20	0	0
" Raw	"	9	0	0
Magnesium Chloride, ex Wharf	"	16	0	0
" Sulphate, Comm.	"	15	10	0
Methylated Spirit, Industrial, 66 O.P.	per gal.	6	3	
Nitric Acid, 80° Tw.	per ton	37	10	0
Oxalic Acid	"	129	0	0
Phosphoric Acid (S.G. 1.750)	per lb.	1	4	
Pine Oil	per ton	Nominal		
Potassium Bichromate	per lb.	1	24	
" Carbonate (hydrated)	per ton	72	10	0
" Chloride	"	21	0	0
" Iodide	per lb.	6	10	
" Amyl Xanthate	"	Nominal		
" Ethyl Xanthate	"	Nominal		
" Hydrate (Caustic) flake	per ton	118	0	0
" Nitrate	per cwt.	4	1	0
" Permanganate	per ton	193	10	0
" Sulphate, 50%	"	20	5	0
Sodium Acetate	"	15	10	0
" Arsenate, 58-60%	"	Nominal		
" Bicarbonate	"	15	0	0
" Bichromate	per lb.	1	0	
" Carbonate (crystals)	per ton	Nominal		
" (Soda Ash) 58%	"	13	15	0
" Chlorate	"	91	0	0
" Cyanide 100% NaCN basis	per cwt.	6	6	6
" Hydrate, 76/77%, solid	per ton	33	0	0
" Hyposulphite, Comm.	"	32	15	0
" Nitrate, Comm.	"	29	0	0
" Phosphate (Dibasic)	"	40	10	0
" Prussiate	per lb.	1	04	
" Silicate	per ton	11	10	0
" Sulphate (Glauber's Salt)	"	9	15	0
" (Salt-Cake)	"	10	0	0
" Sulphide, flakes, 60/62%	"	38	12	6
" Sulphite, Comm.	"	27	15	0
Sulphur, American, Rock (Truckload)	"	14	0	0
" Ground, Crude	"	17	10	0
Sulphuric Acid, 168° Tw.	"	12	0	0
" free from Arsenic, 140° Tw.	"	7	0	0
Superphosphate of Lime, 140° P ₂ O ₅ ..	"	14	18	0
Tin Oxide	"	Nominal		
Titanium Oxide, Rutile	"	172	0	0
" White, 25%	"	85	0	0
Zinc Chloride	"	96	0	0
" Dust, 95/97% (4-ton lots)	"	114	0	0
" Oxide	"	101	0	0
" Sulphate	"	32	0	0

Share Quotations

Shares of £1 par value except where otherwise stated.

GOLD AND SILVER:

	AUG. 4, 1959	SEPT. 8, 1959
SOUTH AFRICA:		
Blinkfont (5s.)	4 18 9	4 12 6
Blyvooruitzicht (2s. 6d.)	1 6 6	1 8 3
Brakpan (5s.)	5 0 0	5 0 0
Buffelsfontein (10s.)	2 11 3	2 8 3
City Deep	1 3 6	1 2 9
Consolidated Main Reef	1 0 6	1 0 0
Crown Mines (10s.)	1 8 3	1 8 3
Daggafontein (5s.)	1 7 9	1 7 6
Dominion Reefs (5s.)	13 9	13 0
Doornfontein (10s.)	1 11 0	1 12 0
Durban Roodepoort Deep (10s.)	1 14 3	1 14 3
East Champ d'Or (2s. 6d.)	2 0 0	2 0 0
East Daggafontein (10s.)	9 0 0	9 0 0
East Geduld (4s.)	1 3 0	1 4 0
East Rand Ext. (5s.)	1 11 3	1 8 6
East Rand Proprietary (10s.)	2 3 3	2 3 3
Freddie's Consol.	2 6 2	2 9 9
Free State Dev. (5s.)	11 6	11 0
Free State Geduld (5s.)	9 12 6	9 5 9
Free State Saaipans (10s.)	1 3 9	1 3 0
Geduld	3 1 9	3 5 0
Government Gold Mining Areas (3d.)	3 6 3	3 9 9
Grootvlei (5s.)	1 0 0	1 0 9
Harmony (5s.)	2 2 9	2 1 6
Hartebeestfontein (10s.)	2 19 3	2 19 0
Libanon (10s.)	12 6	12 0
Lorraine (10s.)	1 15 6	1 14 6
Luipaards Vlei (2s. 6d.)	1 8 3	1 8 3
Marievale (10s.)	1 7 6	1 7 9
Merrispruit (5s.)	5 0 0	5 3 3
Modderfontein B (3d.)	2 0 0	2 6 6
Modderfontein East	17 3	17 3
New Kleinfontein	5 6 3	5 3 3
New Pioneer (5s.)	1 18 3	1 18 0
New State Areas (15s. 6d.)	1 6 6	1 6 6
President Brand (5s.)	3 10 0	3 12 3
President Steyn (5s.)	1 12 6	1 12 3
Rand Leases (9s. 3d.)	7 0 0	6 9 9
Randfontein	1 2 3	1 2 6
Rietfontein (3d.)	5 0 0	5 0 0
Robinson Deep (5s. 6d.)	7 0 0	6 9 9
Rose Deep (3s. 6d.)	10 9	10 0
St. Helena (10s.)	4 6 6	4 3 3
Simmer and Jack (1s. 6d.)	2 0 0	2 0 0
South African Land (3s. 6d.)	1 1 0	1 0 9
Springs (5s.)	1 9	1 9
Stilfontein (5s.)	2 0 6	2 1 9
Sub Nigel (3d.)	12 9	12 2
Vaal Reefs (5s.)	2 1 0	2 1 9
Van Dyk (3d.)	4 0 0	4 9 9
Venterspost (10s.)	16 6	16 6
Virginia (5s.)	6 9 9	6 3 3
Vlakfontein (10s.)	19 3	18 9
Vogelstruisbult (3d.)	9 3 3	7 9 9
Welkom (5s.)	1 3 3	1 1 6
West Driefontein (10s.)	7 8 9	8 0 0
West Rand Consolidated (10s.)	1 1 3	1 2 0
West Witwatersrand Areas (2s. 6d.)	3 11 3	3 11 3
Western Holdings (5s.)	8 17 6	8 8 0
Western Reefs (5s.)	1 6 3	1 6 0
Winkelhaak (10s.)	1 7 3	1 5 6
Witwatersrand Nigel (2s. 6d.)	1 3 3	1 3 3
Zandpan (10s.)	19 9	18 9

RHODESIA:

Cam and Motor (2s. 6d.)	9 0	9 6
Chicago-Gaika (10s.)	17 6	17 6
Coronation (2s. 6d.)	5 0	5 0
Falcon (5s.)	8 6	9 9
Globe and Phoenix (5s.)	1 11 0	1 11 3
Motapa (5s.)	6	9

GOLD COAST:

Amalgamated Banket (3s.)	1 3	1 4 3
Ariston Gold (2s. 6d.)	4 0	5 0
Ashanti Goldfields (4s.)	18 0	1 1 6
Bibiani (4s.)	2 6	3 9
Bremang Gold Dredging (5s.)	2 3	2 6
Ghana Main Reef (5s.)	2 9	3 3
Konongo (2s.)	1 9	2 0
Kwahu (2s.)	4 0	5 0
Western Selection (5s.)	5 3	5 9

AUSTRALASIA:

Gold Fields Aust. Dev. (3s.) W.A.	2 6	2 6
Gold Mines of Kalgoolie (10s.)	9 6	9 3
Great Boulder Proprietary (2s.) W.A.	12 9	12 9
Lake View and Star (4s.) W.A.	1 8 9	1 7 0
London-Australian (2s.)	9	9
Mount Morgan (10s.) Q.	15 6	17 6
New Guinea Gold (4s. 3d.)	1 9	1 9
North Kalguri (1912) (2s.) W.A.	10 9	11 3
Sons of Gwalia (10s.) W.A.	3 0	3 0
Western Mining (5s.) W.A.	10 6	10 9

MISCELLANEOUS:

Fresnillo (\$1.00)	1 11 0	1 11 6
Kenton Gold Areas	2 0 9	1 18 3
St. John d'el Rey, Brazil	3 12 6	3 6 9
Yukon Consolidated (\$1)	5 9	5 9

COPPER:

Bancroft Mines (5s.), N. Rhodesia	1 3 3	1 3 9
Esperanza (2s. 6d.), Cyprus	1 6 1	1 9
Indian (2s.)	4 9	4 9
MTD (Mangula) (5s.)	9 3	9 6
Messina (5s.), Transvaal	5 11 3	5 10 0
Mount Lyell, Tasmania	1 7 0	1 5 6
Nchanga Consolidated, N. Rhodesia	12 2 9	12 15 0
Rhokana Corporation, N. Rhodesia	30 5 0	31 0 0
Roan Antelope (5s.), N. Rhodesia	7 6 6	8 0
Tanganyika Concessions (10s.)	2 7 0	2 5 9

LEAD-ZINC:

Broken Hill South (1s.), N.S.W.	10 9	11 3
Burma Mines (3s. 6d.)	1 9	2 0
Consol. Zinc Corp. Ord.	3 6 9	3 3 0
Lake George (5s.), N.S.W.	3 6	4 0
Mount Isa, Queensland (5s. Aust.)	2 0 3	2 3 9
New Broken Hill (5s.), N.S.W.	1 13 3	1 13 3
North Broken Hill (5s.), N.S.W.	3 15 0	4 1 3
Rhodesia Broken Hill (5s.)	9 3	10 0
San Francisco (10s.), Mexico	19 3	19 9

TIN:

Amalgamated Tin (5s.), Nigeria	7 3	9 9
Ampat (4s.), Malaya	8 9	10 6
Ayer Hitam (5s.), Malaya	1 16 3	1 19 0
Beralit (5s.), Portugal	1 7 0	1 13 3
Bisichi (2s. 6d.), Nigeria	3 9	4 3
Es-Lands (2s.), Nigeria	2 0	2 6
Geevor (5s.), Cornwall	1 3 6	1 5 0
Gold Base Metals (2s. 6d.), Nigeria	1 0	1 3
Hongkong (5s.), Malaya	4 3	4 6
Jantar Nigeria (3s.)	3 6	4 6
Kaduna Syndicate (2s.), Nigeria	2 0	2 0
Kamunting (5s.), Malaya	11 9	12 3
Malayan Tin Dredging (5s.)	19 0	1 1 6
Mawchi Mines (4s.), Burma	2 0	2 3
Naraguta Extended (5s.), Nigeria	1 0	1 3
Pahang (5s.), Malaya	4 9	6 0
Siamese Synd. (5s.)	7 0	8 3
South Crofty (5s.), Cornwall	4 0	5 0
Southern Kinta (5s.), Malaya	1 2 9	1 5 6
Southern Malayan (5s.)	13 3	14 6
Southern Tronoh (5s.), Malaya	11 9	12 9
Sungei Besi (4s.), Malaya	7 9	10 9
Sungei Kinta, Malaya	13 0	14 6
Tekka (12s. 6d.), Malaya	4 6	4 9
Tronoh (5s.), Malaya	13 9	15 9
United Tin Areas (2s. 6d.), Nigeria	9	—

DIAMONDS:

Anglo African Investment	14 11 3	14 12 0
Consol African Selection Trust (5s.)	1 1 0	1 1 9
Consolidated of S.W.A. Pref. (10s.)	11 0	11 0
De Beers Deferred (5s.)	8 13 0	8 10 9

FINANCE, ETC.

African & European (10s.)	4 7 6	4 6 6
Anglo American Corporation (10s.)	9 13 9	9 16 0
Anglo-French Exploration	2 0 3	—
Anglo Transvaal A (5s.)	2 5 0	2 3 9
British South Africa (10s.)	4 13 0	4 13 6
British Tin Investment (10s.)	1 1 6	1 1 6
Broken Hill Proprietary	2 9 6	2 13 0
Camp Bird (10s.)	11 0	12 6
Central Mining	3 18 6	3 17 6
Central Provinces Manganese (10s.)	1 9 3	1 10 0
Consolidated Gold Fields	4 1 6	3 19 0
Consolidated Mines Selection (10s.)	2 4 6	2 4 9
East Rand Consolidated (5s.)	9	9
Free State Development (5s.)	11 3	11 0
General Exploration O.F.S. (2s. 6d.)	6 6	6 3
General Mining and Finance	7 2 3	7 0 3
H.E. Proprietary (5s.)	1 6 0	1 5 0
Johannesburg Consolidated	3 3 3	3 7 6
London & Rhod. M. & L. (5s.)	8 6	8 6
London Tin Corporation (10s.)	8 6	9 3
Lydenburg Est. (5s.)	17 9	16 6
Marsman Investments (10s.)	1 7	1 10 1
National Mining	3 0	2 6
Rand Mines (5s.)	5 0 0	5 3 9
Rand Selection (5s.)	2 18 0	3 0 6
Rhodesian Anglo American (10s.)	4 4 0	4 3 0
Rhodesian Corporation (5s.)	15 3	3 6
Rhodesian Selection Trust (5s.)	15 3	14 6
Rio Tinto (10s.)	2 8 0	2 7 0
Selection Trust (10s.)	5 12 0	5 15 9
South West Africa Co. (3s. 4d.)	15 0	15 0
Union Corporation (2s. 6d.)	3 9 6	3 9 6
Vereeniging	6 12 9	6 15 3
West Rand Inv. Trust (10s.)	2 17 6	3 2 6

THE MINING DIGEST

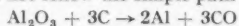
A RECORD OF PROGRESS IN MINING, METALLURGY, AND GEOLOGY

In this section abstracts of important articles and papers appearing in technical journals and proceedings of societies are given, together with brief records of other articles and papers; also notices of new books and pamphlets and lists of patents on mining and metallurgical subjects.

Unconventional Processes for Alumina Reduction

Paper No. 5 presented at the Brisbane Symposium on "Aluminium in Australia," referred to in the August issue, was by J. C. Nixon, group research metallurgist to Consolidated Zinc Pty., Ltd., and entitled a "Review of Unconventional Methods for the Production of Alumina and Aluminium." Following a review of "conventional" processes, including sintering operations, fusion procedures, and wet acid extraction the author says that the weight of evidence suggests that the Bayer process is the most economical method of treating bauxite for the production of the "Analytical Reagent" grade alumina required in the Hall-Héroult reduction furnace and that the stringent specifications on alumina for the Hall-Héroult reduction are necessary because the usual impurity oxides are reduced to metal more readily than aluminium oxide. Even the more electro-positive elements—such as, Ca, Mg, and K—can cause trouble by fouling the electrolyte or by causing poor current efficiencies. He goes on to say that in conventional pyrometallurgical reduction of the base metals the feed to the reduction furnace is impure, the impurities are reduced into the metal, and the crude metal is subsequently refined. However, the best refining process for aluminium requires as much electrical power as the Hall-Héroult reduction and that perhaps the recent advances in the reduction of titanium might be applicable to aluminium. However, the method used most widely—the reduction of titanium chloride by sodium—was the first commercial process for the production of aluminium and it was replaced by the present electrolytic process around the beginning of the 20th Century. Furthermore, it has yet to be decided whether titanium technology will follow that of aluminium in going over to molten salt electrolysis.

A number of alternative electrolytic methods have been proposed for aluminium, including electrolysis of molten aluminium sulphide, chloride, and of organic solutions. Decomposition of aluminium nitride and sulphide has also been studied in detail, but the type of process that Pearson (1955) considers more interesting is the direct reduction of bauxite with carbon. Unfortunately, the author says, the reduction of the alumina in bauxite by carbon does not follow the simple path:



Although some aluminium might be produced by this reaction, the lower aluminium oxides, and particularly carbides such as Al_2O_3 , are formed.

It can be calculated from thermodynamics that the simple carbon reduction reaction could occur at atmospheric pressure at a temperature $1,900^\circ\text{C}$. However, aluminium would boil in the presence of carbon monoxide at $1,750^\circ\text{C}$. It has been suggested that the reaction might be conducted in vacuo to prevent aluminium vapour being oxidized by CO, but evidently no one has been successful in operating a furnace at $1,800^\circ\text{C}$ in vacuo. The other alternative would be shock cooling of the aluminium vapour, which has been tried unsuccessfully in the carbothermic process for producing magnesium. Shock cooling is, however, used successfully in the Imperial Smelting Process (also called the I.V.F. or Improved Vertical Furnace Process) for smelting zinc. The temperatures of the top gases from the blast-furnace are however only $1,000^\circ\text{C}$ and the cooling is done with metallic lead, which fortunately does not contaminate the zinc after cooling beyond the lead content (1.3%) required for galvanizing. In the case of aluminium, any metal coolant apart from aluminium itself would contaminate the aluminium and necessitate a refining step. Molten cryolite has however been patented for this purpose.

The use of other metals to absorb aluminium vapour produced by electro-thermal carbon reduction of alumina to produce alloys has been, and still is, practised successfully. In fact, copper-aluminium alloys containing 30% to 40% aluminium were made as early as 1885 and sold for \$5 per lb. of contained aluminium. Providing the aluminium can be purified, the most interesting possibility is the electrothermic reduction of the ore to an aluminium-silicon alloy containing impurities of iron and titanium. Such alloys containing 40% to 60% Al were produced in Germany in single-phase arc furnaces from 1926-1945 at the rate of 1,300 tons per month.

Direct Reduction

Striplin and Kelley (1947) of the Tennessee Valley Authority investigated the electrothermal reduction of calcined clay and bauxite with coke in single-phase, arc-resistance furnaces of 100, 250, and 600 kW capacities. The design of the furnaces was similar to those employed in the production of ferro-alloys. Low-silica bauxites could not be reduced satisfactorily in these experiments because the charge was volatilized and they had to be mixed with clay or silica. The upper limit of aluminium content in the alloys, which resembled aluminium in appearance and could be cast into

pigs, was 67% Al. A small amount of slag containing alumina and silicon carbide with a melting point higher than the alloy was made. There was no mention of the addition of fluxes to produce a fluid slag and it must be assumed that this was not attempted. Power requirements were estimated from the results at 4.0 kWh/lb. of alloy for a 7,500-kW furnace, which would be equivalent to 7.3 kWh/lb. of aluminium in a 55% Al alloy. (The power requirements of the Hall-Héroult reduction in modern furnaces is about 9 kWh/lb.) Carbon for reduction was supplied by minus $\frac{1}{4}$ -in. coke and a small amount of electrode carbon or graphite. The impurities in the coke and electrodes were not important. Consumption of coke (or char) such as could be obtained from the Blair Athol coal would be equivalent to 0.56 tons coke per ton of alloy. Reduction efficiencies were of the order of 90% of the aluminium, 65% of the silicon, and 100% of the iron and titanium in the charge.

The U.S. Bureau of Mines studied the production of silicon-aluminium alloys in an electric furnace at the Albany research station. Rasmussen (1956) stated that the satisfactory operation of the furnace was very difficult with stoichiometric coke additions "because of high power requirements, excessive electrode consumption, and unfavourable conditions within the furnace requiring frequent shut-downs." Other troubles occurred in three-phase, top-electrode furnaces, such as crusting of the charge, selective reduction of silica, volatilization of metal, and low yields of aluminium. Rasmussen patented a technique in which the molten bath was covered by a deep porous layer of wood waste, sawdust, wood chips, "hog fuel," and other bulky forms of carbon, including lignite. This material provided the greater part of the carbon required for reduction, while the remainder was made up by a dense form of carbon, such as petroleum coke. The charge materials were mixed with the wood waste and descended gradually into the bath. This, the patent claims, had the important effect of avoiding crusting and bridging, allowing the gases to escape freely, insulating the bath, preventing loss of metal by volatilization, avoiding slag formation, reducing the power and electrode consumption, and giving a high yield of metal. Alloys containing up to 60% Al were produced from clay, but it is not known whether attempts were made to obtain higher aluminium contents.

The direct reduction of bauxite to an alloy could be an attractive alternative to the combination of the Bayer and Hall-Héroult processes only if a satisfactory method of refining were available. A low-cost non-electrolytic refining method would be necessary to enable a departure from the conventional processes of manufacture. Several alternative methods have been suggested for refining. They include an amalgamation process developed by Borchers and Schmidt and later Messner, which was carried to the pilot-plant scale by I.G. Farbenindustrie; the Beck magnesium process, developed also by I.G.F. and operated commercially during the Second War; chloride and sulphide distillation processes, and the "Zincal" and related processes.

Without examining the details of all these processes, says the author, the "Zincal" method is selected for discussion. It involves leaching of an Al-Si-Fe-Ti alloy—such as might be produced by direct reduction—with molten zinc which dissolves the aluminium and leaves an insoluble residue con-

taining the iron, silicon, and other impurities. The zinc is then removed from the aluminium by distillation and returned to the leaching stage. The zinc leaching process was suggested in 1939 by Loevenstein, and it has been tested on a pilot-plant scale by Pêchiney (Ménégoz and Belon, 1952). An alloy obtained by direct reduction of clay containing 60% Al, 33% Si, 3% Fe was firstly cooled from 1,000° to 580°, when a solid Fe-Si phase crystallized out leaving a molten layer with a composition of 87.5% Al, 11.7% Si, and 0.8% Fe. The liquid phase was cast, broken up, and leached with molten zinc at 650°, whereby the aluminium dissolved in the zinc and left a solid residue of silicon and iron. The purity of the aluminium obtained after distillation of the zinc increased with the amount of zinc used during the leaching and as the temperature of the separation decreased. Recovery of aluminium from the crude alloy was 83%, the remainder going to the Al-Si-Fe residue, which no doubt could be re-treated for recovery of zinc.

The U.S. Bureau of Mines recently studied the Loevenstein procedure and developed an apparatus that greatly reduced the amount of zinc in circulation, which was one of the chief disadvantages of the original process. The leaching was conducted batchwise under reduced pressure, between 382° C. and 600° C. and preferably between 419° C. and 450° C. The principle involved is that of the Soxhlet extractor in organic chemistry, where the leachant is vaporized, condensed, and continually refluxed. This enabled the zinc-aluminium ratio to be reduced to a minimum of 2.5. The aluminium recovery from the alloy was claimed to be 100%, loss of zinc being negligible, but the final aluminium contained 1.5% Si plus Fe and up to 0.2% Ti. However, if Loevenstein's claims are correct, aluminium of commercial purity could be obtained by careful control of the process or by a second stage of treatment.

Following the successful development of continuous vacuum dezincking of molten lead at Broken Hill Associated Smelters, Port Pirie, construction and operation of the type of apparatus proposed by the U.S. Bureau of Mines seems practicable, given a proper developmental programme. The costs of operation should not be excessive provided the equipment could be scaled up in size. The next stage in the development should however be concerned with the purity of metal obtainable and could be conducted initially on a laboratory scale.

The author concludes by saying that the unconventional processes selected for more detailed discussion—namely, direct electrothermal reduction of bauxite to an alloy and leaching of the alloy with zinc—appear to be attractive possibilities for the treatment of clays or bauxites of very high silica content. The economics of both direct reduction and zinc refining will depend strongly on the amount of silica reduced to the alloy and it is obviously undesirable to have to add a large quantity of silica to a low-silica bauxite of the Weipa type to facilitate its reduction, unless of course a suitable outlet existed for silicon metal or ferrosilicon, which is unlikely.

It would be of interest, he says, to determine whether the improvements to the direct reduction step claimed by Rasmussen, by the use of wood chips, sawdust, lignite, or other bulky forms of carbon, would permit the production of alloys from bauxite containing more than 60% Al. Even

earlier, however, a thermodynamic study of the direct reduction process would be desirable, supplemented if necessary by laboratory experiments to establish whether there are theoretical limitations to the aluminium content of the alloy, if this cannot be ascertained from a detailed study of the available

literature. A true understanding of the direct reduction process might well lead to an improvement in the aluminium content of the alloy and enable direct reduction followed by zinc refining to become more attractive than the combined Bayer and Hall-Héroult processes under Australian conditions.

Rising on a Bore-hole

An account of "Shaft Excavation Using The Bore-hole Rising Method" on an Australian hydro-electric project is given by R. I. Rankin in the *Proceedings of the Australasian Institute of Mining and Metallurgy* for May last (No. 189). The shaft was in Victoria, at the No. 1 Power Station of the Kiewa project. It is to be equipped with a passenger-type lift to give access to the underground chamber of the station, which is being constructed underground because the surface conditions could not provide satisfactory foundations. Station construction involves the excavation of 30,000 cu. yd. of granodiorite and the station will contain six generators, each of 16,000 kW capacity, driven by a 4-nozzle Pelton wheel turbine under a head of 1,730 ft.

Extensive core drilling was carried out before the power station site was fixed and the drilling disclosed a minimum of 70 ft. of totally decomposed rock. In some places hard rock was not located within 150 ft. of the surface. The surface terrain is mountainous, with very steep slopes covered with thick forest. When the vegetation is removed the decomposed rock becomes quite unstable under wet weather conditions and when saturated it forms "running ground." Landslips are frequent wherever excavations are made and also occur naturally.

In these circumstances all work was planned to expedite drainage of the country and the tail-race tunnel was excavated (top half only) into the power station site. An NX drill hole was put down on the centreline of the lift shaft to facilitate drainage and sinking of the shaft commenced. It was proposed to sink only 75 ft. to reach solid rock. As the total shaft depth was only 220 ft. it was desired to avoid the erection of a headframe and 1-cu. yd. buckets of dirt were hoisted by an NCK $\frac{3}{4}$ -cu. yd. excavator, rigged as a crane using the shovel boom. This rig was effective to 75 ft.

At first the shaft was excavated until the walls became weak, at which stage concrete lining was placed. This method had to be abandoned at 30 ft., as the ground became wet and unstable. The shaft was then excavated inside timber spiling to 75 ft., and on reaching this depth concrete lining was placed up to the bottom of the section previously lined.

At the conclusion of this work 116 ft. of shaft remained to be excavated down to the power station arch, at which level a development drive had been driven from tail-race workings to a position under the shaft. This part of the shaft was excavated by the bore-hole method. The advantages of the bore-hole method were believed to be:—

(i) The utmost safety, as men would only travel in the rise under substantial protection.

(ii) The period of exposure to the hazard of loose rock at the face would be extremely small, as initial barring down would be carried out from the

protection of the rising cage. This hazard would be far greater using any other rising method, even if the rise were fully timbered with compartments.

(iii) Any other foreseeable hazard could be eliminated by careful engineering design and by detailed instructions to the crews.

(iv) The rise could be inspected by lifting a flood-light to the face if necessary before men went into the job.

(v) The men would be free from the hazards associated with the handling and erection of stages, rock-drills, etc.

(vi) The bore-hole would be available for forced ventilation from an air hose.

(vii) As the rigging of stages or erection of timber is obviated a greater percentage of the total time becomes available for drilling and firing. The only non-productive times are for smoke removal and travelling the platform to or from the face.

(viii) Partial or total misfires can be dealt with in a safe and expeditious manner.

(ix) The bore-hole serves as a centreline and also as the main hole of a burn cut.

The disadvantages of the bore-hole method could be listed as: (i) Cost of drilling the bore-hole; (ii) cost of winch installation, and (iii) cost of rising cage. These disadvantages are more apparent than real, as a bore-hole is of value for drainage and ventilation. The drilling of a larger hole than would be essential for these purposes is, however, necessary for the bore-hole method.

The surface installation comprised a Thompson (Castlemaine) $7\frac{1}{2}$ -ton, single-drum electric winder, having a rope speed of 150 ft. per min. The winder was fitted with a 6/19 ordinary lay rope of $1\frac{1}{2}$ in. diameter. The headframe consisted of two steel channel sections supported on concrete pads at ground level, which carried a head wheel 48 in. in diameter, running on roller bearings.

The NX hole (3 in. diameter) was drilled on shaft centreline to a depth of 220 ft. by a crew of two men in 10 shifts. This hole deviated 12 in. from the vertical, but this did not affect the work in any way, and the hole was used as the centreline for the pilot rise. Natural overbreak in the jointed rock resulted in an oversize rise, so that the rising cage did not drag on the wall.

A new BX hole was drilled 2 ft. off shaft centre to provide a safe separate route for the communications cable at the conclusion of the sinking operation.

In order to ensure that pieces of rock would not fall into the bore-hole and foul the haulage rope or communications cable, both holes were filled with cement grout, partly washed out and reamed while the grout was still soft. Grouting is considered to be far more satisfactory than casing for this type of rising work. Deviation of the hole could be

minimized by the use of NX drill rods. In the present case the 5-ft. NX barrel was attached to A rods and the drill string further reduced to E size to suit the chuck of the drill head.

The following specifications were laid down to guide the draughtsman who carried out the detailed design of the cage:—

(1) The cage shall comprise two decks, the top deck to be used as a drilling platform and the lower deck as a travelling platform.

(2) The bottom deck shall be enclosed to a height of 3 ft. above the floor to prevent gear (drills, steel, etc.) from protruding out of the cage.

(3) The pilot rise shall be 7 ft. in diameter, to allow: (a) reasonable working space for two drills; and (b) a reasonable bench width (4 ft. 6 in.) for stripping. This requirement indicated a cage diameter of 6 ft.

(4) A ladder (fixed) shall be provided to give access to the top deck through a small trapdoor.

(5) A space to be provided in the trapdoor opening for air and water hoses to the rock-drills.

(6) An escape trapdoor to be provided in the bottom deck and provision made for hanging a chain ladder from the cage.

(7) The top and bottom decks to be provided with sloping guides to prevent the cage from catching on rock projections.

(8) Chains to be provided to suspend the cage from pins in the rise walls during drilling.

(9) Three stabilizing pistons to be provided on the bottom deck.

(10) Air and water inlets to be provided under the bottom deck and air and water manifolds provided just under the top deck. Line oilers to be provided in the permanent pipework.

(11) The method of suspension is to be positive, but must leave the top deck quite clear.

(12) All parts must be capable of transport through a 3 ft. by 5 ft. compartment.

The cage was manufactured in the Kiewa Workshops. The two main problems appeared to relate to the method of attachment of the rope and stability during drilling. These items require detailed discussion.

The rope in use was of 1½ in. diameter, 6 by 19 ordinary lay with a hemp core. It was realized that a non-rotating rope could be advantageous, and such a rope was ordered. However, as it was not available when the job was due to start, the rope described above was used without any difficulties being experienced. The men checked any tendency to spinning merely by touching the walls as they travelled up or down.

As the bore-hole was 3 in. diameter it was considered that any permanent fixture on the rope should not be greater than 2½ in. diameter. The hole was quite smooth after grouting and drilling and no trouble was experienced in passing the rope through the hole. It was further considered to be undesirable to use any clamping method which would require the rope to be bent around a thimble or otherwise fixed with ordinary wire rope clips so that a clamp consisting of two grooved plates bolted together on to the rope was used. It was finally decided to use two such clamps, one below each deck, with a small socket on the end of the rope. The socket was turned with an inverted taper, into which the unstranded ends of the wires were bent and fixed with white metal. The haulage rope thus passed straight through the cage without any

bending. A sample socket was tested and found to develop the full strength of the rope. Even if the clamps were not tight on the rope the bearing between the socket and bottom clamp would safely carry the cage.

The first time the cage was used the clamps were set about 3 in. high—i.e., the bottom clamp was 3 in. above the socket. Pieces of rock up to 300 lb. in weight were barred on to the deck and no slipping was seen. This gave the crew great confidence in the rope and clamps.

It was thought during the design of the cage that, on reaching the drilling position, four steel pins would be inserted into holes drilled during the previous round and chains used to support the cage from the pins. These chains were in fact provided, but were never used as the crew found them superfluous. However, three pistons were provided on the bottom deck to provide lateral stability. The stabilizers were cut out of damaged airlegs to give a cylinder with a piston having a stroke of 24 in. The pistons were made double-acting and all pipework was placed under the bottom deck and well protected. On reaching the drilling position air was admitted simultaneously to all cylinders through a single four-way control valve and the pistons held the cage quite firmly during drilling. Before descending the pistons were retracted by air pressure and a timber wedge placed to prevent the pistons from being accidentally extended during travel.

A separate telephone line (not *via* the rise) was installed to provide direct communication between the rise bottom and the winch driver. To enable the cage to be handled easily a platform was built to carry a low trolley. Extension channels were placed across the shaft and the trolley bearing the cage pushed out under the rise. There was ample room under the stage to allow the bottom rope clamp to be safely connected, but the main reason for the elevated platform was to allow scraping of the broken rock to proceed while drilling was in progress. Firing lines were installed to the bottom of the rise and firing was carried out by the shift foreman from the electric mains firing switch after all men had been evacuated from the area.

Using this cage a crew of three rise men advanced the pilot rise 5 ft. per shift, or at the rate of 105 ft. per week, using continuous rosters. At the same time a scraper crew of two men handled the rock into a chute and provided general assistance at the beginning and end of each cycle. The general aim was to complete one cycle each shift and to fire at the end of the shift. It was clear that, if there were no restriction on firing times, a cycle of 7 hours could be achieved, representing a rate of 120 ft. per week and this could be improved if a longer round could be pulled. In this rise an average of 26 holes were drilled to 5 ft. 3 in., using 34-mm. series integral tungsten steel and two jack-hammers mounted on rising feeds. Explosive consumption was 8 lb. of 60 AN gelignite per foot of rise. Drilling occupied only 4 hours to 4½ hours of each shift and charging up took 1 hour. Smoke, barring down, rigging the cage, and crib occupying the remaining 2½ hours, but handling and moving the cage occupied but a few minutes of this total.

When the pilot rise had holed through the cage was modified by adding chain suspension to improve the stability and by adding a timber deck, 9 ft. in diameter, on top of the bottom deck, so that an additional 18 in. of platform was provided all round.

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The cage was then used to lower the crew to the top of the pilot rise, where the additional platform made a safety cage over the rise and allowed men to move on to the bench and proceed with benching operations to enlarge the shaft to its final diameter of 16 ft. This operation proceeded smoothly and the 100 ft. of shaft was stripped to full size in less than a week.

Subsequently concrete lining was placed, using a 15-ft. lift, and a pour was achieved every 24 hours.

Thus 100 ft. of shaft were excavated and lined to 14 ft. diameter in about three weeks, but time taken to set up the form initially and prepare concrete equipment added a week to this time. However, the completion of 100 ft. of lined shaft in four weeks was considered to be fairly satisfactory.

Following concrete lining two small guides were welded to the cage, to carry two $\frac{1}{2}$ in. diameter guide ropes, and a door was fitted to the cage to allow easy and safe movement of persons on to the cage, which was then used as a service cage for

further construction work in the power station chamber.

It was found that during firing small pieces of rock were shot up the bore-hole with considerable force. It was, therefore, necessary to ensure that any equipment which could be damaged by this blast was not located directly above the hole. It was also necessary that all personnel be warned to keep well clear of the area around the shaft collar when blasting was to take place.

It was noted that when rock was barred down from the face and fell outside the top deck it bounced off the walls of the rise and collected in the bottom deck. Consideration was given to the installing of steel mesh to enclose the bottom deck, but this could have caused rock to jam between the cage and the rise and would have restricted the movements of the crew in guiding the cage during ascent or descent. In any case no damage or difficulty arose, but care was necessary to ensure that drilling equipment was not damaged.

Iron Ores of East Texas

Report of Investigation 5488 of the United States Bureau of Mines, by W. F. Brown, is concerned with "Sampling East Texas Iron Ores." The iron-ore district of that State comprises two contiguous areas known as the North Basin and South Basin. In the North Basin Morris and Cass Counties and parts of Upshur and Marion Counties have commercial iron-ore deposits. The important deposits of the South Basin are in Cherokee, Anderson, and Henderson Counties. The report is concerned principally with four deposits in Morris and Cass Counties and presents the detailed results of drilling and sampling there.

The iron-ore deposits are in the eastern Texas geosyncline of the Gulf Coastal Plain. The region is a dissected plain that slopes gently to the south and south-east. Between the north-east boundary (Sulphur river) and the south-west boundary (Trinity river) are Cypress Creek and the Sabine, Angelina, and Neches rivers and their tributaries; all the principal streams flow south-eastward. Cypress Creek roughly divides the North and South Basins.

Where iron-ore deposits are present the topography is characterized by steep-sided, flat-topped ridges, isolated hills, and narrow valleys. The highest altitudes are about 700 ft. and range from 200 ft. to 250 ft. in the beds of the major streams; the maximum relief is about 500 ft. Much of the iron-ore district is heavily wooded with pine and deciduous trees. Hickory and oak abound at the higher altitudes.

The first published reference to iron ore in east Texas was in 1839. The first iron-ore furnace was put in operation in 1855. Later, during the Civil War, pig-iron and castings were produced by several furnaces in the district for the Confederate Government. Still later more furnaces were built and operated for various intervals until 1911. Of these, one at the State Penitentiary at Rusk, Cherokee County, and the Lone Star furnace at Jefferson, Marion County, were of major importance. The Rusk furnace produced iron from the 1880's to 1909 and the Lone Star was operated intermittently from 1891 to 1911. Sporadic mining and shipping of ore followed, but commercial development on a large

scale was not undertaken until World War II, when Defense Plant Corporation financed construction of several beneficiation plants, blast-furnaces, and a coke plant in or near the area. Most of the facilities were built for and later purchased by Sheffield Steel Corp. and Lone Star Steel Co. The furnaces built for Sheffield at Houston, Tex., and for Lone Star at Lone Star, Tex., have been in continuous operation since 1944 and 1947 respectively. Sheffield obtains an appreciable part of its ore supply from the east Texas deposits and Lone Star depends wholly upon the district for its ore. Expansion of facilities at both plants has been rapid.

Recorded production of iron ore in east Texas before 1943 was 638,222 long tons from which the yield in pig-iron was 282,693 short tons. The recorded output from 1944 to 1955 was 25,231,371 long tons of crude ore and 8,089,306 long tons of usable ore, including 105,667 tons of direct shipping ore, 837,247 tons of sinter, and 7,146,392 tons of washed concentrates. Output in 1955 was 3,107,421 long tons of crude ore and 891,374 long tons of usable ore, including 36,002 tons of direct shipping ore, 170,047 tons of sinter, and 685,325 tons of concentrates.

The formations associated with the iron-ore deposits are in the Claiborne group of Eocene sediments of early Tertiary age and consist of, in ascending order of age: Queen City sand, Weches greensand, and Sparta sand. Deposition took place in shallow seas. The formations have a slight regional dip south-eastward; however, variations in degree and direction of dip are common. The Queen City sand, a light-grey, fine-grained sand or clayey sand, ranges from less than 100 ft. to about 400 ft. in thickness. The formation is exposed on the lower slopes of hills and adjacent bottom lands.

The Weches greensand is composed essentially of beds of glauconitic sand and clay. The glauconite yields iron minerals on weathering; where it is abundant in the formation iron ores occur in economic quantity. The erosion-resistant, ferruginous beds cap many of the hills and ridges throughout the district. The fresh greensand is greenish to nearly black and alters to shades of red,

yellow, or brown. The formation averages somewhat less than 25 ft. in thickness in the North Basin and about 50 ft. in the South Basin. Greensands distinctly different in character and chemical composition were deposited in each of the two basins. The differences are reflected in the types of ore and character of the deposits in the respective basins.

The Sparta sand closely resembles the Queen City sand. Much of the formation has been eroded; remnants covering ferruginous hills and ridges range from a few inches to 100 ft. in thickness.

The brown iron ore (limonite) and carbonate ore (siderite) of the area were derived from the greensand by ordinary weathering. According to the generally accepted theory of origin of the ores, iron was leached from the greensand by ground water and deposited below the top of the water table as the carbonate. During later changes in the position of the water table most of the carbonate was converted to limonite by oxidation. The limonite is composed of amorphous and crystalline hydrous ferric oxides. The siderite is densely crystalline ferrous carbonate. The principal impurities in the ores are silica and alumina, which occur in large part as quartz sand and clay or as residual glauconitic grains. The limonite ores are various shades of yellow, brown, and red, and the siderite ores are grey, greenish, and occasionally reddish when slightly oxidized. Generally the colour of the ore is imparted largely by included impurities.

The limonite of the North Basin occurs as dense to porous nodules or concretions, coalesced to form discontinuous, horizontal lenses and ledges, or as scattered pieces or aggregates in an oxidized matrix composed of sand, clay, and greensand in various proportions. Individual nodules or concretions range from a fraction of an inch to 2 ft. in diameter. The ledges and lenses range from a fraction of an inch to several feet in thickness. The limonite zone attains a maximum thickness of more than 45 ft. in places and averages about 9 ft. The ratio of matrix to ore is rarely more than 6:1 in commercial deposits.

Dense siderite is distributed in similar manner, although generally in lesser abundance, in an unoxidized matrix below the ground-water level. The siderite zone, where present, ranges from a few inches to 65 ft. in thickness. As in the limonite zone individual concretions are of various shapes and sizes; the ledges attain a maximum thickness of about 9 in. but usually are not more than 3 in. thick. The ratio of matrix to ore in the zone ranges from 3½:1 to 10:1. In places beds of partly-oxidized ore and matrix several feet thick overlie the siderite zone.

Ledges of greensand cemented with limonite in the oxidized zone and with siderite in the unoxidized zone are common in some of the deposits. When indurated enough to resist abrasion in milling the material is recovered as concentrate.

Lenses or beds of waste, consisting essentially of sand and clay with or without greensand, are commonly interstratified with the ore beds of both the limonite and siderite zones. In places the waste contains sparse limonite or siderite ore.

The crude limonite ore of commercial deposits in the North Basin analyses 20% to 40% iron and 45% to 65% combined silica and alumina (insoluble) and yields washed concentrates containing 40% to 48% iron and 17% to 22% insoluble material. The crude siderite ore contains 17% to 30% iron, 35% to 55% silica, and 15% to 22% alumina. Con-

centrates assaying 40% to 42% iron and about 12% insoluble material are produced from the crude ore. Phosphorus and sulphur are present in most deposits but generally not in objectionable quantity.

In the North Basin the limonite ore is developed best in places where the overlying Sparta sand is less than 10 ft. to 15 ft. thick. The thickest and richest ore usually occurs in relatively small outlying hills and narrow ridges from which the Sparta sand has been eroded extensively. In large areas where the Weches is covered by 15 ft. or more of sand good limonite ore is not abundant along the outcrop and only siderite ore extends back under the overburden. The central parts of the broader hills are nearly barren of ore.

In the South Basin limonite ore occurs principally as a single, solid, fairly continuous bed at the top of the Weches formation under a relatively thick cover of Sparta sand. The upper 2 in. to 6 in. of the bed is dark-brown, hard, laminated ore. The rest of the bed is composed of "buff crumbly ore"—a compact, massive, brown ore ranging from a few inches to about 4 ft. in thickness. The grade of the crude ore in the South Basin is much higher than that in the North Basin, but the concentrates produced have about the same percentage of iron and slightly less of insoluble materials.

The most extensive mining in the North Basin is carried on by Lone Star Steel Co. Sheffield Steel Corp. engages in smaller-scale mining in both basins. The open-pit method is used entirely. Lone Star Steel Co. obtains accurate data on the overburden, grade, and quantity of ore, and the character of the matrix and any waste zones that may be present by core drilling the deposits on a 100-ft. grid pattern. Preparatory to mining the surface is cleared of trees and brush with bulldozers; the sand overburden is moved outside the limits of the ore-body with scrapers of 18-cu. yd. capacity. Limonite and siderite are mined separately with 2½-cu. yd. or 3-cu. yd. crawler-mounted draglines positioned on top of the ore bed. Thus the haulage trucks are not required to enter the pit, the floor of which is usually clayey or muddy. The draglines have proved adaptable to excavating contained thin layers or lenses of waste separately. Interbedded waste layers, some perhaps more than 3 ft. thick, are removed by scrapers. Deposits in which ledges of siderite or indurated greensand are common are drilled and blasted to aid excavating and loading.

Blending of limonite or siderite ores to facilitate milling is given considerable attention and necessitates careful placing of the draglines. An attempt is made to use the maximum quantity of low-grade ore and still obtain an economic mill feed. The fine ore is proportioned to provide for 30% or less of the concentrates produced. The treatment of ore having a plastic clayey matrix, such as is common in the siderite zone, is improved by the admixture of ore that has a high content of sand. Since late in 1957 knowledge of the amenability of ores to concentration has been obtained by washability tests, which have become an established part of the routine investigations of core-drill samples.

Most of the ore mined to date has been limonite, but the quantity of siderite utilized is being increased. In 1957 about 25% of the ore that was smelted consisted of siderite concentrates. Siderite ore with an exceptionally plastic clay matrix or an unusual quantity of pyrite is stockpiled and allowed to air-slake several months before being milled. Six draglines are operated on a two-shift basis, five

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days a week; five are used for loading trucks and one for casting siderite ore into stockpiles.

Iron ore was mined by Lone Star Steel Co. early in 1957 from two deposits, 3 miles and 8 miles distant from the mill. Thirty cable-dump trailer trucks of 25-ton capacity were used for the longer haul and 20 rear-dump trucks of 15-ton capacity for the shorter haul. The trailer trucks travel up to 50 miles an hour, whereas the rear-dump trucks average about 20 miles an hour. All the haulage roads built by the company are three lanes wide, surfaced with limonite gravel, and well maintained. The mill is on farm-to-market road 250, 1.8 miles east of the town of Lone Star, Morris County. The mill consists of two parallel units, permitting simultaneous and separate treatment of limonite and siderite ores. The capacity of each unit is about 500 tons of crude ore an hour. Treatment consists of crushing, washing, and sizing in successive stages. A company-owned railroad connects the mill with the steel plant, about 3 miles to the south-west.

In 1938 the Federal Geological Survey estimated the "probably available" and "possibly available" iron-ore reserves of east Texas. The tonnages for each classification were in terms of concentrate

containing at least 42% iron that could be produced under certain restrictions with respect to overburden and ratio of ore to waste.

The "probably available" ores are contained in deposits of the North Basin having an average aggregate thickness of at least 18 in. of recoverable concentrate and in deposits of the South Basin having an average thickness of at least 1 ft. of ore. The estimate for the district was 139,000,000 long tons, of which 98,000,000 long tons was in the North Basin and 41,000,000 long tons in the South Basin. Ores classed as "possibly available" in the North Basin are those in deposits having a high ratio of waste to ore and residual boulders of iron ore in the surface soil of farms of the area. Workable deposits in the South Basin in this classification average less than 1 ft. of ore in thickness. Reserve estimates were 12,000,000 long tons and 26,000,000 long tons for the North and South Basins respectively.

The total estimated reserve for both classes of ore in the district was thus 177,000,000 long tons. Carbonate ore was considered to constitute not more than 20% of the ores in the North Basin, to which its occurrence is confined.

Trade Paragraphs

Westinghouse Brake and Signal Co., Ltd., of 82, York Way, King's Cross, London, W. 1, recently issued revised editions of their illustrated catalogues on mine car decking and mine car traversers and traverser equipment.

Morgan Crucible Co., Ltd., of Battersea Church Road, London, S.W. 11, have issued a leaflet which is intended as a general guide for the care and use of crucibles. It contains much useful advice presented in a concise and well-illustrated form, covering such matters as storage, setting, lighting-up, charging, melting and pouring, and cleaning out.

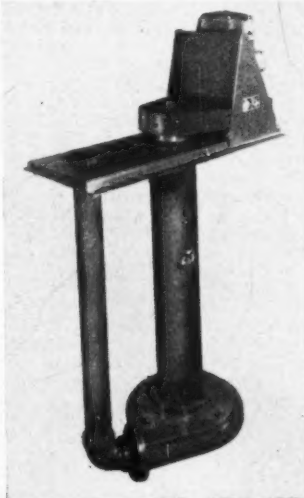
C. and J. Svedberg, Ltd., of Exchange Buildings, Stephenson Place, Birmingham, announce that the name of the company has been changed to **Fagersta Steels, Ltd.** The notice points out that the name of Svedberg has been associated with the import of Swedish steel since the last century and for many years effective control of the company has rested in the hands of Fagersta Bruks A.B., one of the leading Swedish steelmakers.

Pegson, Ltd., of Coalville, Leicester, publish an illustrated catalogue of their crushing, grinding, and screening plant. Listed in this are primary gyratory crushers, single-toggle and double-toggle jaw-crushers, both roller-bearing and plain-bearing types, gyrasphere secondary crushers, intercone tertiary crushers, ball and rod mills, apron feeders, super scrubbers, vibrating screens (including resonance screens), and belt-conveyors. One of the company's large jaw-crushers was described and illustrated in the August issue.

Aero Maintenance Equipment, Ltd., of 47, Victoria Street, London, S.W. 1, make available some further notes on Bennes Marrell handling equipment which refer to the largest tipper truck yet made, weighing 125 tons, which was recently exhibited by the French company at their works at St. Etienne, near Lyons. The machine is mounted on a Berliet

truck, has a 700-h.p. engine, and a pay load of 65 tons. The bucket capacity is 35 cubic metres and it has a dumping angle of 70°. The tipping unit has a single telescopic ram.

Denver Equipment Co., of Denver, Colorado (London office: 15-17, Christopher Street, Finsbury Square, E.C. 2) refer in some recent notes to their SRL rubber-lined vertical sump pumps which are now being produced with capacities from 20 to 1,400 g.p.m. (as illustrated). This newly developed pump operates in small spaces on low horsepower without airlocking. Casing liners and runners are of soft rubber bonded to steel inserts and wear as much



as six times longer when pumping abrasive material than hard iron or steel parts. It is specially suitable for cyclone service and can operate in sumps as much as 12 ft. deep.

Nordberg Manufacturing Co., of Milwaukee, Wisconsin (London office: 19, Curzon Street, W. 1) refer to a new bulletin which describes the Symons "Protecto-Lube" system developed to assure users of Symons cone-crushers of optimum results from their machines. This lubricating unit is readily adaptable for use with crushing and processing equipment now in the field as well as with many other types of mechanical equipment. Illustrations include the completely enclosed unit which protects the oil supply, pump, and other working parts from dust and falling rock, and several interior views showing arrangement of the components.

Cyanamid International, of 30, Rockefeller Plaza, New York (British representatives: Cyanamid of Great Britain, Ltd., Bush House, London, W.C.2) in a recent leaflet in their series of *Regional News* draw attention to pellettized Aerozanthates which are dust free and easier to handle. These are formed under uniform pressure to about $\frac{1}{8}$ in. diameter and resist degradation in transit and handling and are said also to improve working conditions and dissolve quickly and uniformly. Their higher bulk chemistry means lower transport cost. The leaflet refers also to the range of mining chemical reagents which the company can provide—such as, promoters, frothers, depressants, surface active agents, and cyanide.

Lodge-Cottrell, Ltd., of George Street Parade, Birmingham, make the following statement:—"As announced in the Press at the time of the purchase of their share capital, Lodge-Cottrell, Ltd., continue to operate as a separate company in the same manner as before this transaction and have retained in their service all their staff and the three full-time directors of their former Board. Mr. Richards, who is already past retiring age, will shortly be retiring but will be retained on the board, while Mr. Busby and Mr. Watkins remain full-time directors of the company, thus maintaining continuity of management and of service to and contact with their clients. Plant and design will be based on and evolved from their successful designs of the past, which have enabled them to maintain their position both as pioneers and as leaders in the field of electro-precipitation. Being supported now by the greater financial resources and research and development facilities of Simon-Carves, Limited, they will be able to offer even better service in the future."

Huntington, Heberlein and Co., Ltd., of Simon House, 28-29, Dover Street, London, W. 1, a subsidiary of **Simon-Carves, Ltd.**, of Cheadle Heath, Stockport, are to build a large sinter plant for Richard Thomas and Baldwins, Ltd., at their Redbourne steelworks near Scunthorpe. With a capacity of 32,000 tons of sinter per week (16,000 tons per week from each of two continuous sintering machines) the installation will be one of the major plants in the United Kingdom. Simon-Carves (Australia) Pty. Ltd., have received from the Sulphide Corporation (subsidiary of the Consolidated Zinc Corporation) a contract of over £A1,000,000 for a lead and zinc sinter plant at Cockle Creek in New South Wales. The sinter plant will be designed in London by Huntington, Heberlein and Co., Ltd., but the major part of the plant and equipment will be manufactured in Australia. The sinter plant, which is expected to be in opera-

tion by March, 1961, is part of the Sulphide Corporation's £A8,000,000 zinc smelter project, work on the first part of which is to begin before the end of this year.

Caterpillar Tractor Co., Ltd., of P.O. Box No. 162, Glasgow, recently announced that the opening of their new tractor plant at Tannockside during the week August 24-29 in the presence of officials from the parent company at Peoria, Illinois. They have lately added a new No. 933 Series F Traxcavator to their range. This machine has a new four-cylinder engine, rated at 25 flywheel horsepower, which differs in several features from the former engine. The fuel pump housing contains the barrel and plunger assemblies, a new round fuel rack, and a horizontal-acting governor, in one compact unit. Permitting easier adjustment and longer wear for all parts, the housing requires less space alongside the engine. Service life of the power train for the series has been lengthened by several modifications. The bottom of the bevel gear and transmission compartments has been increased in thickness to increase strength and an improved brake offers full-contact braking with 30% less operator effort. Final drives have been strengthened by the use of wider heavier teeth on pinions and gears. Easier service is provided by pressing on gears and locking them in place with a retainer nut. Unfastening the nut provides immediate removal of the entire assembly. Use of a new cluster gear in the transmission introduces a higher speed reverse for faster backing. A new, 1-yd. heavy-duty bucket replaces the former 1-yd. bucket.

Powell Duffryn, Ltd., of 8, Great Tower Street, London, E.C. 3, announce that they have changed the name of their subsidiary Cambrian Wagon and Engineering Co., Ltd. This will in future be known as the Powell Duffryn Engineering Co., Ltd., the address remaining the same—namely, Cambrian Works, Maundy, Cardiff. Over recent years the company has diversified its interests and activities and, while still remaining specialists in all forms of railway rolling stock, has established itself in the manufacture of equipment for the petroleum, chemical, and allied industries and in a wide field of heavy precision and structural engineering. In addition to the manufacture of all forms of standard cylindrical and rectangular tanks the company has carried out large bulk storage installations at various locations in the U.K. These have included individual tanks of up to 2,500,000 gallons capacity and similar tanks have been supplied in pre-fabricated form for erection overseas. Included in this range of work are process and pressure vessels. The company undertakes plant design and fabrication in mild steel, specification and stainless steels, and aluminium alloys, having available modern machining capacity and comprehensive testing and inspection facilities including weld radiographic examination.

This year the company has taken a major step forward in the fields of materials handling and transportation, the statement adds, by becoming sole licensed manufacturers within the U.K. for the complete range of mobile materials handling equipment of Dempster Brothers Inc., of Knoxville, Tennessee. This makes available highly flexible systems of economic bulk collection, transportation, setting down, or dumping of process materials and products.

LeTourneau-Westinghouse Co., of Peoria, Illinois, announce the production of a new off-road hauler, as illustrated. The truck is available in three sizes:

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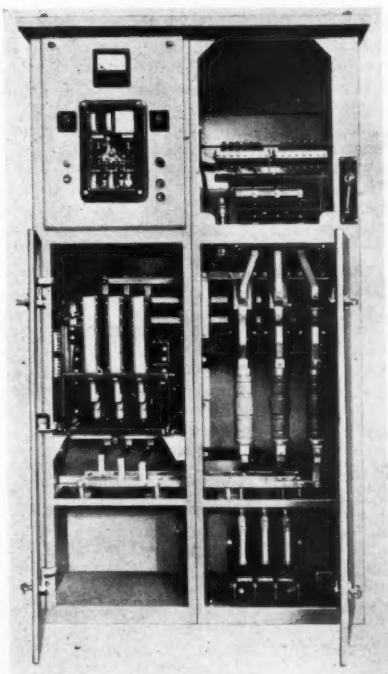


**Le Tourneau-
Westinghouse
"Haulpak"
Truck**

27-ton and 32-ton end dump models and an 80-ton bottom dump. The units are called the "Haulpak" line and in place of springs have pneumatic suspension. The 27-ton model is powered by a Cummins 335-h.p. turbocharged engine and operates at speeds up to 35.4 m.p.h. With a Cummins 375-h.p. turbocharged engine the 32-ton model has speeds up to 38.8 m.p.h. The 80-ton Haulpak bottom-dump is powered by a Cummins V-12, 450-h.p. engine and operates at speeds up to 40 m.p.h. All three have torque converters which provide four forward speeds and two reverse. They incorporate automatic lock-up to eliminate torque converter slip and utilize maximum engine speed for higher truck speed. The makers point out that the use of the "Hydrair" suspension system and box-beam frame have allowed the design of a better loading and better dumping body. While the Haulpak provides greater ground clearance its body cradles its load low, thus lowering the centre of gravity and improving stability. The body interior is free of a dump-retarding tail lip and lets the twin hydraulic hoists raise the body to 70° for dumping full loads completely in only 15 seconds. To keep wet and cold material from sticking to the body surface an exhaust-heated body is standard equipment. Exhaust circulates through the hollow box-section supports of the body, with outlets located at the rear away from the operator. The 80-ton bottom-dump has been developed for use in coal strip mining operations where big capacity haulers are desired to make extraction more economical. The struck capacity of this 80-ton unit is 100 cu. yd. In a separate announcement the company gives some particulars of Model C Speedpull, which is the latest addition to their range of scrapers, having a 26-h.p. rig with 20-cu. yd. heaped capacity. It has the same Hydrair suspension system as the Haulpak truck range.

Belmos Co., Ltd., of Bellshill, Lanarkshire, issue some notes on the type K contactor starter designed for the direct-on-line starting of 3.3 kV motors up to 600 h.p. It is housed, complete with control and protective equipment, in a pillar which may be free-standing or grouped with similar units to

form a switchboard. The pillar comprises two main compartments containing the contactor on the left, and the current transformers on the right, fuse-links, and control circuit transformer. Above the main compartments are the instrument and isolator chambers (see illustration). The main busbars, fitted when the pillar is in switchboard form, have



a continuous rating of 1,000 amps. and can withstand a through fault of 150 M.V.A. for 3 seconds. These busbars and the medium-voltage a.c. and d.c. buswires and sequence wires, which are fitted when required, run in separate horizontal ducts behind the instrument and isolator chambers. The contactor and magnet assembly is mounted on a chassis which can be withdrawn from the enclosure for inspection or maintenance, the main connexions between the chassis and enclosure being made by means of blade and clip contacts at the rear. The isolator is fully interlocked and is designed for either Forward/Off/Reverse or On/Off/Earth connexion. Up to twelve auxiliary switches, d.c. or a.c., of 25 amps. rating each, can be fitted. The contactor operating coil is d.c.-supplied from a germanium rectifier and 3,300/110 volt transformer housed within the pillar. Comprehensive control arrangements can be provided, including sequence interlocking and automatic sequence starting. Overload and earth leakage protection is provided by a thermal relay, while back-up protection is provided by fuse-links with a rupturing capacity of 150 M.V.A. at 3.3 kV. The incoming and outgoing cableways are connected at the back of the unit in separate compartments. Auxiliary cable glands are mounted on the base of an auxiliary terminal chamber so that access to them can be obtained without removing the cover of the 3.3 kV. cable terminals.

RECENT PATENTS PUBLISHED

A copy of the specification of the patents mentioned in this column can be obtained by sending 3s. 6d. to the Patent Office, Southampton Buildings, Chancery Lane, London, W.C. 2, with a note of the number and year of the patent.

5,998 of 1945 (814,195). R. C. TAYLOR and H. L. PICKERING. Production of uranium metal.

25,249 of 1955 (815,364). H. ISHIZUKA. Continuous vacuum refining of sponge titanium.

27,167 of 1955 (816,477). DORR-OLIVER INC. Hydro-cyclone washing system.

29,194 of 1955 (813,834). ALUMINIUM LABORATORIES, LTD. Recovery of fluoride material from used aluminium reduction cell linings.

37,549 of 1955 (814,181). MINISTER OF SUPPLY. Production of titanium.

2,720 of 1956 (816,398). ELTRO G.m.b.H. Recovery of metals, including silicon and germanium.

18,239 of 1956 (814,755). NATIONAL SMELTING CO., LTD. Transfer of zinc vapour from furnace to condenser.

19,844 of 1956 (815,074). UNITED KINGDOM ATOMIC ENERGY AUTHORITY. Refining of metals by zone melting.

29,969 of 1956 (817,080). AMERICAN SMELTING AND REFINING CO. Treatment of germanium-bearing materials.

2,090 of 1957 (816,017). NATIONAL DISTILLERS AND CHEMICAL CORPORATION. Reduction of multivalent hydrides.

19,708 of 1957 (814,790). FLUID ENERGY PROCESSING AND EQUIPMENT CO. Communication of material.

36,135 of 1957 (816,282). BROWN, BOVERI U. CIE. A.G. Production of very pure gallium.

39,372 of 1957 (816,367). WESTERN ELECTRIC CO., INC. Zone-melting process.

NEW BOOKS, PAMPHLETS, ETC.

Publications referred to under this heading can be obtained through the Technical Bookshop of *The Mining Magazine*, 482, Salisbury House, London, E.C. 2.

Economics of the Mineral Industries : A Series of Articles by Specialists. A.I.M.E. Seeley W. Mudd Series Volume. Edited by EDWARD H. ROBIE. Cloth, octavo, 755 pages, illustrated. Price 90s. New York : American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc.

The Diamond Industry in 1957-1958. By A. MOYAR. Paper covers, 131 pages, illustrated. Price 15s. Antwerp : Vlaams Economisch Verbond.

Selected Bibliography of Andalusite, Kyanite, Sillimanite, Dumortierite, Topaz, and Pyrophyllite in the United States. U.S. Geol. Survey Bulletin 1019-N. By A. B. GRAMETBAUER. Paper covers, pp. 973-1046, with map. Price 45 cents. Washington : Superintendent of Documents.

Regional Geology and Mineral Resources of the Olary Province. Geol. Surv. S. Australia Bulletin No. 34. By B. CAMPANA and O. KING. Paper boards, 133 pages, illustrated, with maps. Price 7s. 6d. Adelaide : Department of Mines.

Northern Rhodesia : The Karoo System and Coal Resources of the Gwembe District, North-East Section. N. Rhod. Geol. Survey Bulletin No. 1. By H. S. GAIR. Paper boards, 88 pages, illustrated, with maps. Price 30s. Lusaka : Geological Survey.

Summary of the Geology of Tanganyika : Part I—Introduction and Stratigraphy. Tang. Geol. Survey Memoir No. 1. By A. M. QUENNELL, A. C. M. MCKINLAY, W. G. AITKEN. Paper covers, 264 pages, with map. Price Shs. 20. Dar Es Salaam : Government Printer.

Uganda : The Geology of Southern Mengo. Uganda Geol. Survey Report No. 1. By J. W. PALLISTER. Paper boards, 122 pages, with maps. Price Shs. 50. Entebbe : Geological Survey of Uganda.

British Guiana : The Gold Deposits of the Cuyuni River. Brit. Guiana Geol. Survey Bulletin 27. By R. T. CANNON. Paper covers, 69 pages, with maps. Price \$1.00. Georgetown, Demerara : Geological Survey.

North Borneo : The Geology and Mineral Resources of the Jesselton-Kinabuluan Area. Brit. Territories in Borneo Geol. Surv. Dept. Memoir 6. By P. COLLENETTE. Paper boards, 193 pages, illustrated, with map. Price 14s. Kuching, Sarawak : Government Printer.

The Solomon Islands : Geological Exploration and Research, 1953-1956. Geol. Surv. Brit. Solomon Islands Memoir No. 2. By JOHN C. GROVER. Paper boards, folio, 151 pages, illustrated. Price 40s. London : Crown Agents for Overseas Governments and Administrations.

Northern Rhodesia Chamber of Mines Year Book, 1958. Paper boards, 91 pages, illustrated. Kitwe : Chamber of Mines.

Year Book of the American Bureau of Metal Statistics : 38th Annual Issue, 1958. Paper covers, 137 pages. Price \$4.75, post free. New York : American Bureau of Metal Statistics.

Statistiques, 1958 : Minerais et Metaux Soc. Anon. Paper covers, 162 pages, illustrated. Paris 8^e : Minerais et Metaux.

Metalli Non Ferrosi E Ferroleghie : Statistiche, 1958. Paper covers, 148 pages. Rome : Azienda Minerale Metallici Italiani.

Selected Index to Current Literature

This section of the Mining Digest is intended to provide a systematic classification of a wide range of articles appearing in the contemporary technical Press, grouped under heads likely to appeal to the specialist.

* Article in the present issue of the MAGAZINE.

† Article digested in the MAGAZINE.

Economics

Coal, United Kingdom : *Statistics, 1958.* Statistics Relating to Mechanized Output for 1958. *Inform. Bull. N.C.B.* No. 59/208.

***Finance, Mining :** *Survey, 50-Year.* Mining Finance Over 50 Years. H. A. HAKE, THE MINING MAGAZINE, July, Sept., 1959.

***Handling, Mineral :** *Port, Germany.* New Coal and Coke Loading Installation for Emden. J. GRINDROD, THE MINING MAGAZINE, Sept., 1959.

Iron, Steel : *Survey, United States.* Iron and Steel: The Palay Report in Retrospect. J. D. SULLIVAN, *Min. Engg.*, Aug., 1959.

***Oil-Shale, United States :** *Process, New.* New Process for Oil Shale. J. A. EDWARDS, THE MINING MAGAZINE, Sept., 1959.

Production, Australia : *Gold, Western.* Mine Modernization at Lake View and Star. *Chem. Engg. Min. Rev.* (Melbourne), June 15, 1959.

Production, Canada : *Copper, Quebec.* A Great Canadian Enterprise: Gaspé Copper, Ltd. The Staff, *Canad. Min. Metall. Bull.*, July, 1959.

Production, Canada : *Nickel, Ontario.* The Falconbridge Story. *Canad. Min. J.*, July, 1959.

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Resources, United States : *Barite-Fluorite, Kentucky.* John Burdette Barite-Fluorite Deposit, Garrard County. K. M. EARL, *Rep. Inv. U.S. Bur. Min.* 5480.

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†**Resources, United States :** *Iron, Texas.* Sampling East Texas Iron Ores. W. F. BROWN, *Rep. Inv. U.S. Bur. Min.* 4588.

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†**Steam, Geothermal :** *Utilization, New Zealand.* Drilling Procedures at N.Z. Geothermal Steam Project. *Chem. Engg. Min. Rev.* (Melbourne), May 15, 1959; *MINING MAG. Digest*, Aug., 1959.

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Geology

***Economic, Africa :** *Uranium, Nyasaland.* Radioactive Minerals in Southern Nyasaland. V. L. BOSAZZA, THE MINING MAGAZINE, Aug., 1959.

Economic, Australia : *Gold, Western.* The Oroya Shoot and Its Relationship to Other Flatly Plunging Ore Pipes at Kalgoorlie. S. A. TAMICH, *Proc. Aust. Inst. Min. Metall.*, June, 1959.

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Economic, Canada : *Monazite, Ontario.* Monazite as an Ore Mineral in Elliott Lake Uranium Ores. S. M. ROSCOE, *Canad. Min. J.*, July, 1959.

Economic, Egypt : *Deposits, Phosphate.* Association of Phosphates with Synclines and Its Bearing on Prospecting for Phosphates in Sinai. M. J. YOUSSEF, *Egypt. J. Geol.*, Vol. 2, No. 2, 1958.

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Structural, Canada : *Trench, Rocky Mountain.* Symposium on the Rocky Mountain Trench. *Canad. Min. Metall. Bull.*, May, 1959.

Water, India : *Provinces, Resources.* Ground-water Provinces of India. G. C. TAYLOR, *Econ. Geol.*, June-July, 1959.

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